International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)
Fifth Meeting of the Air Traffic Management / Communications, Navigation and Surveillance Subgroup (ATM/CNS/SG/5) - ATM Committee
Lima, Peru, 13-17 November 2006

Agenda Item 5: Draft amendment to the CAR/SAM Regional Plan for the Implementation of CNS/ATM Systems

(Prepared by the Secretariat)

SUMMARY

This working paper contains the draft amendment to the CAR/SAM Regional Plan for the Implementation of CNS/ATM Systems, which was denominated Plan for the Transition to the ATM Operational Concept **(Appendix A)**, taking into account the guides contained in the new Global Air Navigation Plan, which are in the phase of approval by the ICAO Council. This transition plan was mainly based on the Global Plan Initiatives approved at the AP/ATM/12 meeting for use in the CAR/SAM Regions.

References:

- CAR/SAM Regional Plan for the Implementation of CNS/ATM Systems
- Global Air Navigation Plan
- Report of the AP/ATM/12 meeting

1. Introduction

1.1 Following the progress made by the States and Regional Planning and Implementation Groups in the implementation of CNS/ATM systems, within the framework of the Global Air Navigation Plan for CNS/ATM Systems (Doc. 9750), it was acknowledged that technology was not an end in itself and that a complete global integrated ATM system concept, based on clearly established operational requirements, was needed. This concept, in turn, would serve as the foundation for the coordinated implementation of CNS/ATM technologies, also based on clearly established requirements. In order to develop the concept, the ICAO Air Navigation Commission established the Air Traffic Management Operational Concept Panel (ATMCP).

1.2 The Global ATM Operational Concept, developed by the aforementioned panel, was approved by the Eleventh Air Navigation Conference, and published as Doc. 9854 AN/458, through recommendation 1/1, as follows:

a) ICAO, the States and the planning and regional implementation groups (PIRGs) should consider the concept as the common global framework to guide ATM system implementation and concentrate ATM development efforts;

b) The global ATM concept should be used as high-level guidance for the development of ICAO CNS/ATM provisions;

c) States, with the support of other members of the ATM community, should undertake the task of validating the seven components of the global ATM operational concept;

d) ICAO, the States and the PIRGs should develop transition strategies for ATM systems implementation based on the global ATM operational concept; and

e) ICAO should align its technical programme to facilitate future efforts regarding the ATM operational concept.

1.3 Within the context of the AN-Conf/11, the sixth consultation meeting between the Air Navigation Commission and the industry was held in Montreal, on the topic of “Promoting the implementation of the recommendations of the 11th Air Navigation Conference”. Among the issues addressed, “The global ATM — from concept to reality” produced the following conclusion:

“That all partners that are in a position to do so, work together to prepare a common road map or a global action plan, in order to generate operational benefits in the short and medium term, and that the said document be made available to ICAO in mid October 2004 for presentation to the Air Navigation Commission and so that its inclusion in the Global Plan may be considered.”

1.4 The industry road map included CNS/ATM implementation activities for the short and medium term, while the long-term objectives are considered in the operational concept. As a result, the Commission declared that the road map was perfectly in line with the operational concept and that continued positive results would ensure its convergence with the ATM system envisaged in the operational concept and the formation of a complete planning structure, together with the Global Plan and that concept.

1.5 ICAO started developing the new Global Air Navigation Plan to adjust global planning to the conclusions of the Eleventh Air Navigation Conference, particularly insofar as the Global ATM Operational Concept and the Industry Road Map were concerned. The Global Air Navigation Plan not only includes the global ATM operational concept, but focuses on a series of “Global Plan Initiatives (GPIs)” that offer the necessary conditions for the implementations aimed at benefiting the ATM community in the short and medium term.

1.6 The AP/ATM/12 meeting, after analysing the agreements reached at the NAM/CAR ATM meeting, and based on work projects already started in the SAM Region, formulated *Conclusion AP/ATM/12/02 Implementation of Work Programmes to Support Strategic Performance*, in which seven projects for the CAR/SAM Regions were established, with a view to supporting the transition from a system-based to a performance-based approach. These projects are the following:

a) Optimisation of the ATS route structure

b) Improve demand and capacity balancing

c) Alignment of the upper airspace classification (CAR Region)

d) Implementation of RNP approaches

e) Improving ATS inter-facility data communication

f) Improving situational awareness

g) Implementing the flexible use of airspace

2. Analysis

2.1 The Plan for the Transition to the ATM Operational Concept in the CAR/SAM Regions shown as **Appendix A** to this working paper has been developed taking into account the Global Air Navigation Plan. Its objective is to apply the Global Plan Initiatives (GPIs) in order to begin the transition towards the ATM Operational Concept.

2.2 Furthermore, this Plan seeks to establish an implementation strategy aimed at deriving short- and medium-term benefits for the ATM community, based on ATM-related infrastructure and available and foreseen aircraft capabilities. The document shall also describe in detail the air navigation infrastructure (CNS, AIS, MET, AGA/AOP) and the institutional aspects involved, which are necessary to accompany this evolution.

2.3 The specific chapters related to the aforementioned navigation infrastructure and institutional aspects should be developed by the AGA/AOP, AIS, HRT and MET Subgroups, by the CNS Committee and by the Institutional Aspects Task Force, taking into account the operational requirements established in Chapter 4, as well as the guides of the GPIs involved, and the introductory text to each of the specific chapters, based on those ATM operational requirements, as per the following table:

Chapter 5 – Communication	CNS Committee
Chapter 6 – Navigation	CNS Committee
Chapter 7 - Surveillance	CNS Committee
Chapter 8 – Meteorology	MET Subgroup
Chapter 9 – AIS	AIS/MAP Subgroup
Chapter 10 – Aerodromes and Ground Aids/Aerodrome Operational Planning	AGA/AOP Subgroup
Chapter 11 – Training of human resources	HRT Subgroup
Chapter 12 – Institutional aspects	Institutional Aspects Task Force

3 Suggested action

3.1 The meeting is invited to:

a) Take note of the information presented in this working paper;

b) Analyse the Draft Plan for the Transition to the ATM Operational Concept which is attached as Appendix A to this working paper, propose the necessary changes, and approve Chapters 1, 3 and 4, which would correspond to the ATM Committee;

c) Consider the delivery of the Draft Plan for the Transition to the ATM Operational Concept to the AGA/AOP, AIS, HRT and MET Subgroups, the CNS Committee and the Institutional Aspects Task Force, for the drafting of the remaining chapters.

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APPENDIX A

INTERNATIONAL CIVIL AVIATION ORGANIZATION

PLAN FOR THE TRANSITION TO THE ATM OPERATIONAL CONCEPT IN THE CAR/SAM REGIONS

Version 1.0

October 2006

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Chapter 1: Introduction

1.1 Objective

1.1.1 The Plan for the Transition to the ATM operational concept in the CAR/SAM Regions has been developed taking into account the Global Air Navigation Plan. Its objective is to apply the Global Plan Initiatives (GPIs) in order to start the transition to the ATM operational concept.

1.1.2 This Plan also aims to establish an implementation strategy that will yield benefits for the ATM community in the short and long term, based on the ATM-related infrastructure and existing and foreseeable aircraft capabilities. The document even contains the air navigation infrastructure (CNS, AIS, MET, AGA/AOP) and considers the institutional aspects needed for that evolution.

1.2 Scope

1.2.1 This transition plan extends to the boundaries of the CAR/SAM Regions and in the short and medium term, respectively, will last up to 2010 and from 2011 to 2015, as indicated in the guidelines of the Global Air Navigation Plan. As they are gradually developed and approved, the long-term initiatives required for the evolution to a global ATM system, as shown in the global ATM operational concept, will be added to this Plan.

1.3 Background

1.3.1 In the early 1980s, civil aviation recognised the growing limitations of the existing communications, navigation, surveillance (CNS) and air traffic management (ATM) systems and the need to make improvements to overcome those limitations and meet future needs. As a result, the ICAO Council established the Special Committee on Future Air Navigation Systems (FANS) in 1983 to study new concepts and technologies and to recommend a system for overcoming both existing and foreseeable problems and to take aviation into the 21^{st} century.

1.3.2 The FANS Committee made an extensive study of existing systems and new technological applications. Its conclusion was that the limitations of the current systems were intrinsic to the systems themselves and were so restrictive to effective Air Traffic Management that the problems could not be resolved on a global scale, except by introducing new concepts and new CNS systems that would support more efficient ATM. The FANS Committee concluded that the use of satellite technology was the only viable solution for overcoming the limitations of the current system and meeting future needs on a cost-effective global basis.

1.3.3 Since its very first meeting in Caracas, Venezuela in April 1991, the CAR/SAM Regional Planning and Implementation Group (GREPECAS) started working on CNS/ATM aspects. Its work in principle consisted of collecting information from members of the CAR/SAM Regions that were serving on the FANS Committee (Phase II).

1.3.4 The 10th Air Navigation Conference of ICAO in September 1991 endorsed the CNS/ATM systems concept developed by the FANS Committee. It recommended that ICAO complete and maintain a coordinated global plan and do the planning for the implementation of the future CNS/ATM systems through the ICAO Regional Planning and Implementation Groups. The FANS Committee completed the coordinated global plan in October 1993. Consequently, on 9 March, 1994, the ICAO Council approved the ICAO General Policy Statement on CNS/ATM Systems Implementation and Operation, which appears as ***Appendix 1*** to this chapter.

1.3.4 At its second meeting, held in Fort Lauderdale, United States, GREPECAS decided to create a Subgroup responsible for CNS/ATM transition planning in the CAR/SAM Regions.

1.3.5 During its fifth meeting, in 1995, GREPECAS, upon approving a first version of the CAR/SAM Regional Plan for the Implementation of CNS/ATM Systems, considered the task of the CNS/ATM Subgroup to have ended and immediately afterwards established the CNS/ATM Implementation Coordination Subgroup (CNS/ATM/IC/SG).

1.3.6 The CNS/ATM/IC Subgroup has prepared the Action Plan as a complementary document to this CNS/ATM Plan. Developed based on the identification of Homogeneous Areas and Main Traffic Flows, it contains more detailed texts and is linked structurally to the Facilities and Services Implementation Document (FASID) used in the regional planning process.

1.3.7 GREPECAS/9, upon analysing aspects related to the new CNS/ATM systems, identified the need to have an integrated planning, particularly with respect to the evolution of air traffic management and the related communications, navigation and surveillance infrastructure. Consequently, through conclusion 9/20, it established the ATM/CNS Subgroup, which brought together specialists in the operational and technical areas and was broken down into two committees: ATM and CNS.

1.3.8 These two committees together form the CNS/ATM Subgroup, whose name was changed to ATM/CNS Subgroup to better reflect future efforts. Its structure has permitted appropriate coordination and avoided duplication of efforts, since the two committees meet separately during Subgroup meetings and come together as the ATM/CNS for coordination purposes. The Subgroup was also given responsibility for establishing a harmonized working programme for its committees and overseeing and adjusting its development.

1.3.9 It was recognised, after the progress made in the implementation of the CNS/ATM System by States and Regional Planning and Implementation Groups within the framework of the Global Navigation Plan for CNS/ATM Systems (Doc. 9750), that technology does not constitute an end in itself and that a complete, integrated global ATM system concept was needed, based on clearly-established operational requirements. This concept, in turn, was to constitute the grounding for the coordinated implementation of CNS/ATM technologies, also based on clearly-established requirements. The ICAO Air Navigation Commission set up the Air Traffic Management operational concept Panel (ATMCP) to develop the concept.

1.3.10 The global ATM operational concept developed by the above-cited panel was approved by the Eleventh Air Navigation Conference published as Doc. 9854 AN/458 through recommendation 1/1, which stipulates the following:

a) ICAO, the States and the planning and regional implementation groups (PIRGs) should consider the concept as the common global framework to guide ATM system implementation and concentrate ATM development efforts;

b) The global ATM concept should be used as high-level guidance for the development of ICAO CNS/ATM provisions;

c) States, with the support of other members of the ATM community, should undertake the task of validating the seven components of the global ATM operational concept;

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1.3.11 The sixth consultation meeting between the Air Navigation Commission and the industry took place in Montreal after the AN-Conf/11, on the topic of "Promoting the implementation of the recommendations of the 11th Air Navigation Conference". Among the issues addressed, "The global ATM – from concept to reality" produced the following conclusion:

"That all partners that are in a position to do so, work together to prepare a common road map or a global action plan, in order to generate operational benefits in the short and medium term, and that the said document be made available to ICAO in mid October 2004 for presentation to the Air Navigation Commission and so that its inclusion in the Global Plan may be considered."

1.3.12 The industry road map included CNS/ATM implementation activities for the short and medium term, while the long-term objectives are considered in the operational concept. As a result, the Commission declared that the road map was perfectly in line with the operational concept and that continued positive results would ensure its convergence with the ATM system envisaged in the operational concept and the formation of a complete planning structure, together with the Global Plan and that concept.

1.3.13 ICAO started developing the new Global Air Navigation Plan to adjust global planning to the conclusions of the Eleventh Air Navigation Conference, particularly insofar as the Global ATM Operational Concept and the Industry Road Map were concerned. The Global Air Navigation Plan not only includes the global ATM operational concept, but focuses on a series of "Global Plan Initiatives (GPIs)" that offer the necessary conditions for the implementations aimed at benefiting the ATM community in the short and medium term.

1.4 Deficiencies of the current System in the CAR/SAM Regions

1.4.1 Air Traffic Management (ATM)

1.4.1.1 The ATM currently available in the CAR/SAM Regions suffers from some inconveniences, including the following:

a) The lack of a harmonized airspace operations concept with broad use of performance-based navigation through an RNAV and/or RNP navigation specification for en-route and TMA flights, hinders airspace design and management, by not permitting the implementation of an optimum airspace structure.

b) Failure to use the navigation capability of currently available aircraft creates an unfavourable cost-benefit ratio for aircraft operators.

c) Failure to systematically use cost-benefit analyses for the implementation of new airspace structures creates problems for the establishment of air navigation infrastructure implementation priorities and impedes the measurement of the benefits obtained by the ATM community.

d) Lack of a policy and procedures for flexible airspace use makes airspace design and management difficult by not allowing for the application of an optimum airspace structure and use of optimum flight trajectories.

e) Lack of air traffic flow management services in most airspaces in the CAR/SAM Regions causes congestion in some airspaces and airports and makes it impossible to maximise the use of ATC and airport capacities, to the detriment of their users.

f) Lack of coordination in the provision of current CNS/ATM services can occasionally result in a duplication of resources and services.

g) Inadequate quality of means of communication and language problems create problems in the provision of Air Traffic Services.

h) Because different separation criteria in FIR boundaries (with and without ATS surveillance) are applied, limiting the use of optimum flight profiles, the lack of ATS surveillance in some parts of the airspace of the Regions makes it impossible to have a harmonised reduction of aircraft separation.

i) Lack of harmonisation of ATM automation in the CAR/SAM Regions and the little sharing of ATS surveillance data create discontinuity in ATS services.

1.4.2 Oceanic CNS

1.4.2.1 CNS systems that can currently be used over oceanic areas in the CAR/SAM Regions have limitations. Thus, in most cases, air-ground communications are limited to partial VHF coverage provided from continental coastal areas and from some islands, and to HF frequency coverage, often requiring intermediate communicators. Some States/Territories and International Organizations are testing CPDLC systems that should be operational shortly. Most aircraft have INS/IRS and/or GNSS navigation systems that offer the necessary conditions for implementing RNP 10 in the South Atlantic and in the route segment between Lima and Santiago, Chile, permitting a reduction of lateral separation to 50 NM. Surveillance has been limited to pilot position reports via VHF and HF communications. Some States are testing ADS systems that should be operational shortly. Even so, continuing limitations result in the application of large separations in oceanic airspace that restrict the use of optimum flight profiles.

1.4.2 Continental CNS

1.4.2.1 Because of the presence of mountains and extended jungles in some areas of the CAR/SAM Regions, it is difficult to implement and maintain the present communications, navigation and surveillance systems. Even so, VHF communications coverage in the upper continental airspace (above FL 245) of the CAR/SAM Regions is almost 100%. The existing and planned radar coverage would reach more than 80% of the upper airspace. The maintenance of this equipment is quite costly for CAR/SAM States and alternatives should be studied and implemented to reduce these costs. The performance achieved frequently limits air traffic management, given the limitations of speech communication and failures of existing equipment.

1.4.2.2 The reliability, capacity, data integrity and capability to handle bit-oriented messages of the present ground communications system, the Aeronautical Fixed Telecommunications Network (AFTN), are limited, although some States are implementing AMHS systems.

1.5 Evolution and Transition

1.5.1 In considering the overall system concept, the questions of evolution and transition are most important. It will be necessary to ensure inter- and intra-regional CNS/ATM system harmonisation in order to optimise investments in airborne systems and ensure that aircraft are not unnecessarily required to carry a multiplicity of equipment and operators are not obliged to request multiple operational approvals. Furthermore, there is a need to ensure that differences in the pace of development around the world do not lead to incompatibility between elements of the ATM operational concept among the ICAO Regions. Particularly because of the wide scope of these components, , the above considerations call for judicious coordination of regional and worldwide planning and implementation if such systems are to be optimised.

Appendix 1 to Chapter 1

ICAO GENERAL POLICY STATEMENT ON CNS/ATM SYSTEMS IMPLEMENTATION AND OPERATION

Approved by the Council (C 141/13) on 9 March 1994

Fulfilling its mandate under Article 44 of the Convention on International Civil Aviation by, *inter alia*, developing international air navigation principles and techniques and fostering the planning and development of international air transport so as to ensure the safe and orderly growth of international civil aviation throughout the world, the International Civil Aviation Organization (ICAO), recognising the limitations of the present ground-based system, developed the ICAO communications, navigation and surveillance/air traffic management (CNS/ATM) systems concept, which uses satellite technology. ICAO considers that an early introduction of the new systems will contribute to the healthy growth of international civil aviation.

The implementation and operation of the new CNS/ATM systems shall adhere to the following precepts:

1. UNIVERSAL ACCESSIBILITY

The principle of universal accessibility without discrimination shall govern the provision of all air navigation services provided by way of the CNS/ATM systems.

2. SOVEREIGNTY, AUTHORITY AND RESPONSIBILITY OF THE CONTRACTING STATES

Implementation and operation of CNS/ATM systems, which States have undertaken to do in accordance with Article 28 of the Convention, shall neither infringe nor impose restriction upon the sovereignty, authority or responsibility of the States in the control of air navigation and the promulgation and enforcement of safety regulations. The authority of the States shall be preserved in the coordination and control of communications and in the augmentation, as necessary, of satellite navigation services.

3. RESPONSIBILITY AND ROLE OF ICAO

In accordance with Article 37 of the Convention, ICAO shall continue to discharge the responsibility for the adoption and amendment of Standards, Recommended Practices and Procedures governing the CNS/ATM systems. In order to secure the highest practicable degree of uniformity in all matters concerned with the safety, regularity and efficiency of air navigation, ICAO shall coordinate and monitor the implementation of CNS/ATM systems on a global basis, in accordance with the regional air navigation plans and the global coordinated CNS/ATM systems plan of ICAO. In addition, ICAO shall facilitate the provision of assistance to States with regard to the technical, financial, managerial, legal and cooperative aspects of implementation. The role of ICAO in the coordination and use of the frequency spectrum in respect of communications and navigation in support of international civil aviation shall continue to be recognised.

4. TECHNICAL COOPERATION

In the interest of globally coordinated, harmonious implementation and early realisation of benefits to States, users and providers, ICAO recognises the need for technical cooperation in the implementation and efficient operation of CNS/ATM systems. Towards this end, ICAO shall play its central role in coordinating technical cooperation arrangements for CNS/ATM systems implementation. ICAO also invites States in a position to do so to provide assistance with respect to technical, financial, managerial, legal and cooperative aspects of implementation.

5. INSTITUTIONAL ARRANGEMENTS AND IMPLEMENTATION

The CNS/ATM systems shall, as far as possible, make optimum use of the existing organisational structure, modified if necessary, and shall be operated in accordance with existing institutional arrangements and legal regulations. In the implementation of CNS/ATM systems, advantage shall be taken, where appropriate, of rationalisation, integration and harmonisation of systems. Implementation should be sufficiently flexible to accommodate existing and future services in an evolutionary manner. It is recognised that a globally coordinated implementation, with full involvement of the States, users and service providers through, *inter alia*, regional air navigation planning and implementation groups, is the key to the realisation of full benefits from the CNS/ATM systems. The associated institutional arrangements shall not inhibit competition among service providers complying with relevant ICAO Standards, Recommended Practices and Procedures.

6. GLOBAL NAVIGATION SATELLITE SYSTEM

The global navigation satellite system (GNSS) should be implemented as an evolutionary progression from existing global navigation satellite systems, including the global positioning system (GPS) of the United States and the global orbiting navigation satellite system (GLONASS) of the Russian Federation, towards an integrated GNSS over which Contracting States exercise a sufficient level of control on aspects related to its use by civil aviation. ICAO shall continue to explore, in consultation with Contracting States, airspace users and service providers, the feasibility of achieving a civil, internationally controlled GNSS.

7. AIRSPACE ORGANISATION AND UTILISATION

The airspace shall be organised so as to provide for efficiency of service. CNS/ATM systems shall be implemented so as to overcome the limitations of the current systems and to cater for evolving global air traffic demand and user requirements for efficiency and economy, while maintaining or improving the existing levels of safety. While no changes to the current organisation of flight information regions are required for implementation of the CNS/ATM systems, States may achieve further efficiency and economy through consolidation of facilities.

8. CONTINUITY AND QUALITY OF SERVICE

Continuous availability of service from the CNS/ATM systems, including effective arrangements to minimise the operational impact of unavoidable system malfunctions or failure and achieve expeditious service recovery, shall be assured. Quality of system service shall comply with ICAO Standards of system integrity and be accorded the required priority, security and protection from interference.

9. COST RECOVERY

In order to achieve a reasonable cost distribution among all users, any recovery of costs incurred in the provision of CNS/ATM services shall be in accordance with Article 15 of the Convention and shall be based on the principles set forth in the Statements by the Council to Contracting States on charges for Airports and Air Navigation Services (Doc 9082), including the principle that it shall neither inhibit nor discourage the use of the satellite-based safety services.

Chapter 2: Air Traffic in the CAR/SAM Regions

2.1 Traffic Forecasts in the CAR/SAM Regions

TBD

Chapter 3: Planning Considerations

3.1 Introduction

3.1.1 As traffic volumes grow worldwide, the demands made on air navigation service providers in a given airspace increase, as do the complexities of air traffic management. With the increase in traffic density, the number of flights unable to follow optimum flight trajectories rises.

3.1.2 Implementation of the components of the ATM operational concept is expected to provide sufficient capacity to meet the growing demand, while generating additional benefits in the way of more efficient flight profiles and increased levels of safety. The potential of new technologies to significantly reduce service costs, however, calls for the establishment of clearly-defined operational requirements.

3.1.3 Considering the benefits to be derived from the ATM operational concept, many timely decisions are required for its implementation. There will be a need for unprecedented global and regional cooperation.

3.1.4 The regional planning process is the principal engine of the planning and implementation work of ICAO. It is here that the top-down approach, comprising global guidance and regional harmonisation measures converges with the bottom-up approach constituted by States/Territories/International Organizations and aircraft operators and their proposals for implementation options.

3.1.5 In its most elementary form, the output from the regional planning process is a listing of air navigation facilities, together with their achievable time frames. This data is essential for implementation of the Global Plan Initiatives that will guide the gradual transition to the ATM operational concept. These lists will be incorporated into the CAR/SAM Regional Air Navigation Plan (ANP) and kept up to date by the CAR/SAM Regional Planning and Implementation Group (GREPECAS), with the assistance of ICAO Regional Offices.

3.1.6 This Plan calls for the gradual, coordinated, timely and cost-effective global implementation of the ATM operational concept components, bearing in mind the Global Plan Initiatives (GPIs) that could be implemented in the short and medium term. The Plan fulfils two important functions in this connection:

a) It offers regional planning institutions, States/Territories, service providers and users guidelines for the transition to the ATM operational concept.

b) It operates as a measuring stick to gauge progress.

3.1.7 Planning the implementation of ATM operational concept components, as well as the elaboration of orientation guidelines to ensure a harmonious and integrated implementation, should be basically a regional responsibility, while the implementation is the responsibility of the States/Territories or groups of States/Territories and International Organisations, working together within the framework of the concept and implementation strategy developed by GREPECAS for the two Regions. However, it is imperative for each State in the CAR and SAM Regions to develop and publish its own plan for the transition to the ATM operational concept.

3.1.8 Regional planning should take into consideration the features intrinsic to the components of the ATM operational concept, the scope of whose facilities may transcend national boundaries, making it necessary to implement multinational facilities to avoid duplicating resources and services. In establishing multinational facilities, the institutional aspects involved, which generically encompass all technical, operational, administrative, financial and legal matters, should be taken into account.

3.1.9 The establishment of Regional Multinational Organisations is to be expected, given the aspects cited in the previous paragraph and the need to develop a suitable structure for the planning and implementation of multinational facilities. These bodies, made up of groups of States, would guarantee that optimum use is made of the investments needed to implement and maintain air navigation services.

3.2 Homogeneous ATM areas and main international traffic flows

Homogeneous ATM area

3.2.1 A homogeneous ATM area is an airspace with a common ATM interest, based on similar characteristics of traffic density, complexity, air navigation system infrastructure requirements or other specified considerations wherein a common detailed plan will foster the implementation of interoperable ATM systems. Homogeneous ATM areas may extend over States, specific portions of States or groups of States. They may also extend over large oceanic and continental areas. They are considered areas of common interests and requirements.

3.2.2 According to the ATM operational concept, homogeneous ATM and/or routing areas should be reduced to a minimum and consideration should be given to merging adjacent areas.

Main traffic flows

3.2.3 A main traffic flow refers to the concentration of a significant volume of air traffic on the same or proximate flight paths. Main traffic flows may cross several homogeneous ATM areas with different characteristics.

3.2.4 Homogeneous ATM areas and main traffic flows are related primarily to en-route airspace. However, addressing capacity and efficiency improvements in the terminal control area (TMA) and at aerodromes and working on the basis of a set of common initiatives will serve as an important building block toward achieving a homogeneous ATM system. Therefore, several of the Global Plan Initiatives were developed specifically to improve aerodrome and TMA operations.

3.2.5 The most significant air traffic flows in the CAR/SAM Regions extend over both Regions and many of them reach the boundaries of the CAR/SAM Regions with the AFI, EUR, NAM, NAT and PAC Regions. **Appendix 1** to this chapter specifies the Main Traffic Flows identified in Homogeneous Areas.

3.3 Planning methodology

3.3.1 After identifying the homogeneous ATM areas and main traffic flows, a task in which the CAR/SAM Regions have already progressed significantly, GREPECAS conducted a survey of the current and foreseen aircraft population and its capabilities, predicted traffic figures, and also the ATM infrastructure, including human resource availability and requirements, among other things. An analysis of the data collected made it possible to identify performance "gaps". The Global Plan Initiatives were then evaluated against those gaps to identify those that would most appropriately provide the operational improvements necessary to meet performance objectives in the CAR/SAM Regions and will be described in further detail in the following chapters.

3.3.2 This planning process would continue with the development of various options for the implementation of initiatives, a cost-benefit analysis of the various options and preliminary development of infrastructure support requirements. Additional steps would include development of implementation plans and funding profiles, further review of human resource requirements to support the identified initiatives, followed by further cost-benefit analyses. Finally, national and regional implementation plans would be developed or amended based on the selected initiatives. This is an iterative process, which may require repetition of several steps until a final choice of initiatives is made. Once available, the planning tools will assist GREPECAS in carrying out the aforementioned steps. Figure 1 is an illustration of a planning flow chart.

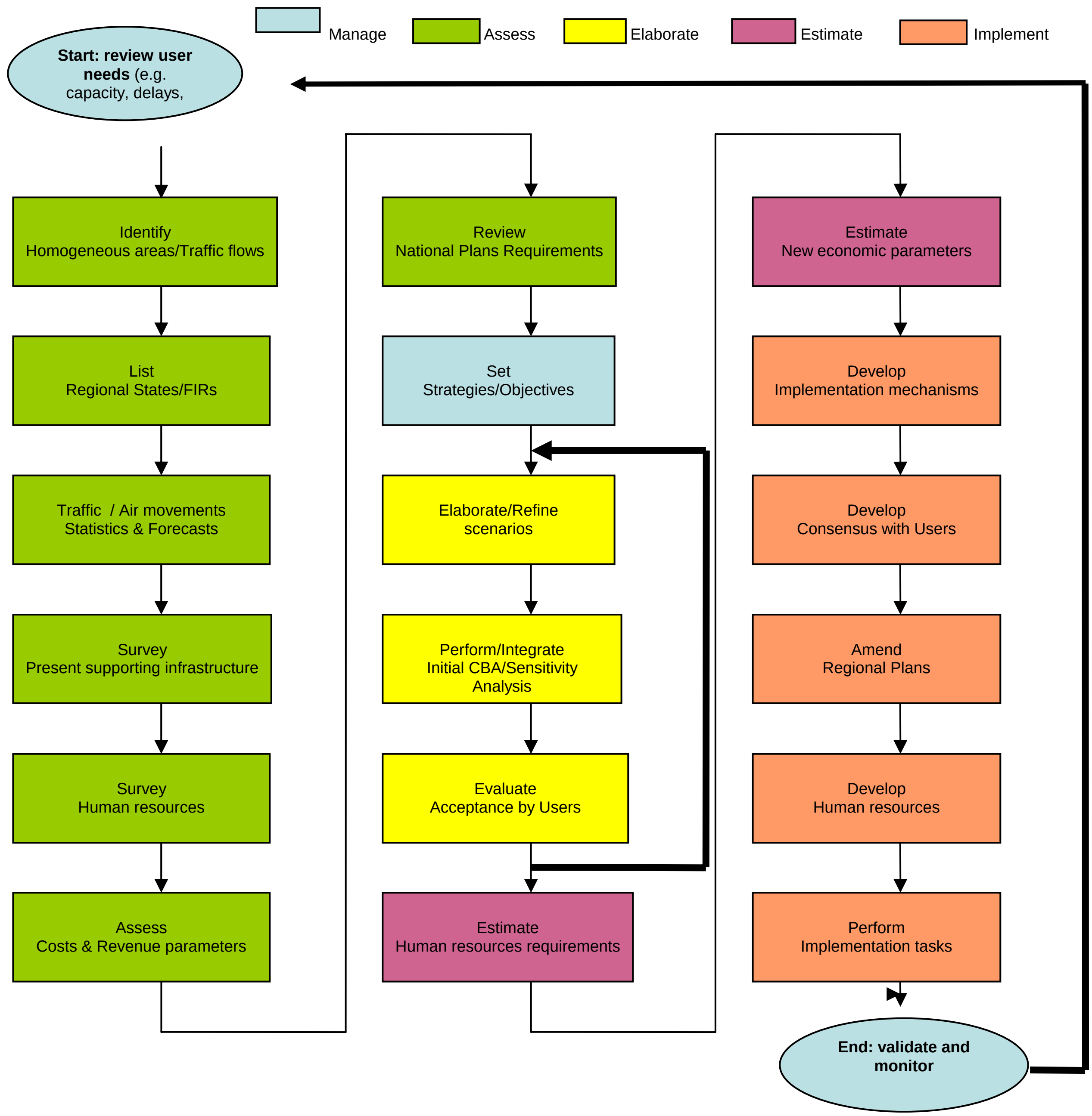

Figure 1. Planning Flow Chart

3.3.3 Development of work programmes is based on the experience and lessons learned in the previous cycle of the CNS/ATM implementation process. This Plan therefore, focuses efforts toward maintaining consistent regional harmonisation and improving implementation efficiencies by drawing on the existing infrastructure capabilities and regional implementations.

3.4 Planning tools

3.4.1 This Transition Plan should be supported by planning tools which take various formats (*e.g.*, software applications, planning documentation, web-based reporting forms, project management tools, etc.), with a view toward following up on and ensuring the coordination of projects establishing the GPIs, performance objectives and implementation periods, together with the resulting timetables and action plans.

3.5 Evolution

3.5.1 Achieving the global ATM system sought after will be accomplished through the implementation of many initiatives over several years on an evolutionary basis. These initiatives were established to support planning and implementation of performance objectives in the CAR/SAM Regions. The set of initiatives contained in this Transition Plan are meant to facilitate and harmonise the work already underway within the CAR/SAM Regions and to bring needed benefits to aircraft operators over the near and medium term. ICAO will continue to develop new initiatives on the basis of the operational concept that will be included in the Global Plan and, as a result, in this Transition Plan.

3.5.2 The ATM System in the CAR/SAM Regions shall be based on the provision of integrated services. In order to describe how these services shall be provided, seven components of the ATM operational concept, jointly with key concept services are described in Doc 9854. The performance objectives were logically linked to the components of the ATM operational concept, in order to ensure that the work has as a goal to reach the ATM system described in the operational concept. Thus, the term Components of the ATM Operational Concept used in the current plan are referred to the seven components described in the ATM operational conept. These are: Airspace Organization and Management (AOM), Demand and Capacity Balancing (DCB), Aerodrome Operations (AO), Traffic Synchronization (TS), Conflict Management (CM), Airspace User Operations (AUO) and ATM Service Delivery Management (ATMSDM).

3.5.3 In all cases, initiatives must meet global objectives based on the operational concept. On this basis, planning and implementation activities begin with the application of available procedures, processes and capabilities. The evolution would progress to application of emerging procedures, processes and capabilities and ultimately, migrate to the ATM system based on the operational concept. Figure 2 depicts the Global Plan evolution.

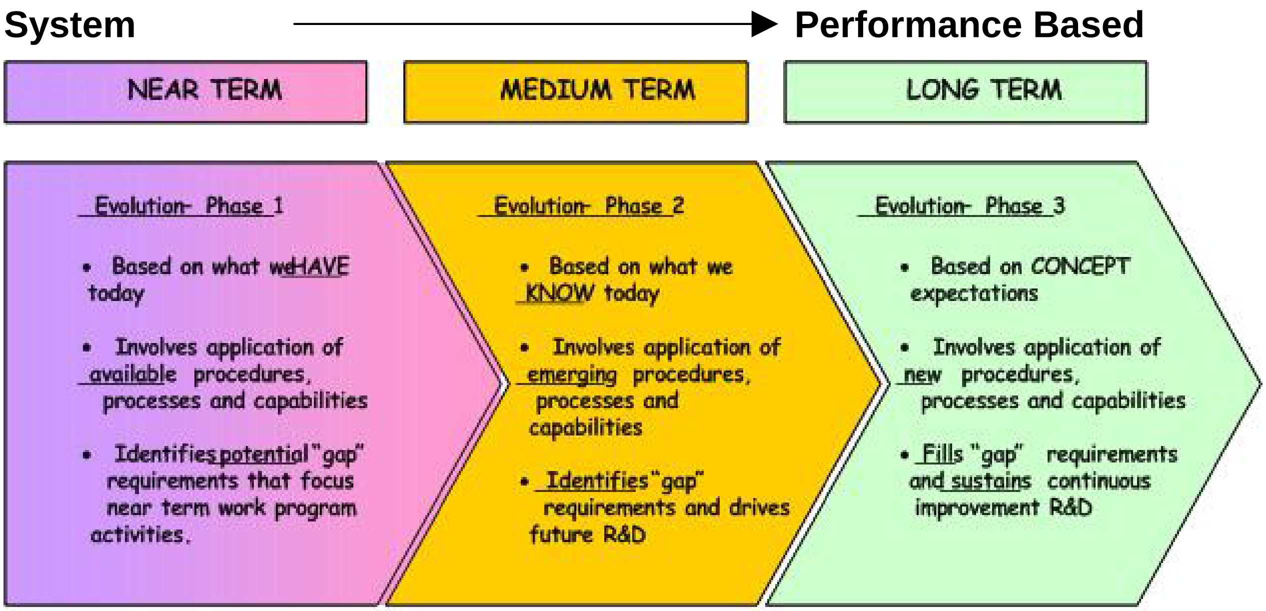

Figure 2. Global Plan Evolution

3.6 Global Plan Initiatives

3.6.1 Table 3-1 sets out the Global Plan Initiatives (GPIs) that can be considered by GREPECAS and by States, Territories and International Organisations. The initiatives in this Transition Plan will be inserted into each of the following chapters, broken down by ATM, CNS, AGA, MET, AIS, and other areas of operation. Planning and implementation for each of the initiatives should be started in the near term and progressed in an evolutionary manner. Long-term initiatives, necessary to guide the evolution to a global ATM system as envisioned in the operational concept, will be added to the Global Plan and, therefore, to this Transition Plan, as they are developed and agreed to.

Note: *The Global Plan contains the objective and relevant implementation strategy for each initiative.*

3.7 Integration of initiatives

3.7.1 The GPIs are provided to facilitate the planning process and should not be viewed as stand-alone tasks, but rather, in many cases, as interrelated. Therefore, initiatives are quite capable of integrating with and supporting each other. In fact, integration is a sought after goal of a global ATM system.

GPI		En-route	Terminal area	Aerodrome	Supporting infrastructure	Related Operational Concept Components
GPI-1	Flexible use of airspace	X	X			AOM, AUO
GPI-2	Reduced vertical separation minima	X				AOM, CM
GPI-3	Harmonise level systems	X				AOM, CM, AUO
GPI-4	Uniform upper airspace classifications	X				AOM, CM, AUO
GPI-5	RNAV and RNP (Performance based navigation)	X	X	X		AOM, AO, TS, CM, AUO
GPI-6	Air traffic flow management	X	X	X		AOM, AO, DCB, TS, CM, AUO
GPI-7	Dynamic and flexible ATS route management	X	X			AOM, AUO
GPI-8	Collaborative airspace design and management	X	X			AOM, AUO
GPI-9	Situational awareness	X	X	X	X	AO, TS, CM, AUO
GPI-10	Terminal area design and management		X			AOM, AO, TS, CM, AUO
GPI-11	SIDs and STARs with RNP and RNAV		X			AOM, AO, TS, CM, AUO
GPI-12	Functional integration of ground systems with airborne systems		X		X	AOM, AO, TS, CM, AUO
GPI-13	Aerodrome design and management			X		AO, CM, AUO

GPI		En-route	Terminal area	Aerodrome	Supporting infrastructure	Related Operational Concept Components
GPI-14	Runway operations			X		AO, TS, CM, AUO
GPI-15	Match IMC and VMC operating capacity		X	X	X	AO, CM, AUO
GPI-16	Decision support systems	X	X	X	X	DCB, TS, CM, AUO
GPI-17	Implementation of data link applications	X	X	X	X	DCB, AO, TS, CM, AUO, ATMSDM
GPI-18	Aeronautical information	X	X	X	X	AOM, DCB, AO, TS, CM, AUO, ATMSDM
GPI-19	Meteorological systems	X	X	X	X	AOM, DCB, AO, AUO
GPI-20	WGS-84	X	X	X	X	AO, CM, AUO
GPI-21	Navigation systems	X	X	X	X	AO, TS, CM, AUO
GPI-22	Communication infrastructure	X	X	X	X	AO, TS, CM, AUO
GPI-23	Aeronautical radio spectrum	X	X	X	X	AO, TS, CM, AUO, ATMSDM

Table 3-1 Global Plan Initiatives and their links to the main groups

Appendix 1 to Chapter 3

Homogeneous Areas and Main Traffic Flows Identified

-1- Routing area (RA)	-2- Traffic flows	-3- FIRs involved	-4- Type of area covered	-5- Remarks
Caribbean/South American (CAR/SAM) Regions				
AR 1	Buenos Aires-Santiago, Chile	Ezeiza, Mendoza, Santiago	Low-density continental	SAM intra-regional traffic flow
	Buenos Aires-Sao Paulo/Rio de Janeiro	Ezeiza, Montevideo, Curitiba, Brasilia	High-density continental	SAM intra-regional traffic flow
	Santiago, Chile-Sao Paulo/Rio de Janeiro	Santiago, Mendoza, Córdoba, Resistencia, Asunción, Curitiba, Brasilia	Low-density continental	SAM intra-regional traffic flow
	Sao Paulo/Rio de Janeiro-Europe	Brasilia, Recife, Atlantic	Low-density continental / oceanic	SAM/AFI/EUR inter-regional major traffic flow
AR 2	Sao Paulo/Rio de Janeiro-Miami	Brasilia, Amazónica, Maiquetía, Curacao, Kingston, Santo Domingo, Port au Prince, Havana, Miami	Low-density continental / oceanic	CAR/SAM/NAM inter- and intra-regional traffic flow
	Sao Paulo/Rio de Janeiro-New York	Brasilia, Amazónica, Paramaribo, Georgetown, Piarco, Rochambeau, San Juan (New York)	Low-density continental / oceanic	CAR/SAM/NAM /NAT inter- and intra-regional traffic flow
AR 3	Sao Paulo/Rio de Janeiro - Lima	Brasilia, Curitiba, La Paz, Lima	Low-density continental	SAM intra-regional traffic
	Sao Paulo/Rio de Janeiro - Los Angeles	Brasilia, Amazónica, Bogotá, Barranquilla, Panama, Central America, Mérida, Mexico, Mazatlán (Los Angeles)	Low-density continental	CAR/SAM/NAM inter- and intra-regional traffic flow
AR 4	Santiago - Lima - Miami	Santiago, Antofagasta, Lima, Guayaquil, Bogotá, Barranquilla, Panama, Kingston, Havana, Miami	Low-density continental / oceanic	CAR/SAM/NAM inter- and intra-regional traffic flow
	Buenos Aires - New York	Ezeiza, Resistencia, Asunción, La Paz, Amazónica, Maiquetía, Curacao, Santo Domingo, Miami (New York)	Low-density continental / oceanic	CAR/SAM/NAM /NAT inter- and intra-regional traffic flow

-1- **Routing area (RA)**	-2- **Traffic flows**	-3- **FIRs involved**	-4- **Type of area covered**	-5- **Remarks**
	Buenos Aires - Miami	Ezeza, Resistencia, Córdoba, La Paz, Amazónica, Bogotá, Barranquilla, Kingston, Havana, Miami	Low-density continental / oceanic	CAR/SAM/NAM inter- and intra-regional traffic flow
AR 5	Northern South America - Europe	Guayaquil, Bogotá, Maiquetía, Piarco (NAT-EUR)	High-density continental / oceanic	SAM/CAR/NAT/ EUR inter-regional traffic flow
AR 6	Santiago - Lima - Los Angeles	Santiago, Antofagasta Lima, Guayaquil, Central America, Mexico, Mazatlán	Low-density oceanic	CAR/SAM/NAM inter- and intra-regional traffic flow
AR 7	South America – South Africa	Ezeiza, Montevideo, Brasilia, Atlantic Johannesburg (AFI)	Low-density oceanic	SAM/AFI inter-regional traffic flow
	Santiago, Chile – Easter Island - Papeete (PAC)	Santiago, Pascua, Tahiti	Low-density oceanic	SAM/PAC inter-regional traffic flow
G-1	Mexico, Toluca, Guadalajara, Monterrey, Mazatlán, La Paz, Acapulco, Puerto Vallarta, Huatulco, Cancún Gulf of Mexico — North America	Mexico, Houston, Miami; Albuquerque; Los Angeles	High-density continental/oceanic	CAR/NAM inter-regional main traffic flow
	Cancún, Guatemala, El Salvador, Nicaragua, Honduras, Costa Rica - Miami	Mexico, Central America, Havana, Miami	High-density continental/ oceanic	CAR/NAM inter-regional traffic flow
GM-2	Mexico, Cancun, Havana, Nassau — Europe	Mexico, Havana, Miami –(NAT-EUR)	High-density continental/ oceanic Main traffic flow	CAR/NAM/NAT /EUR inter-regional traffic flow
GM-3	Costa Rica, Panama, Honduras, Kingston, Haiti, Santo Domingo, San Juan, Caribbean — Europe	Central America, Panama, Kingston, Port-au-Prince, Curacao, Santo Domingo, San Juan – EUR	High-density oceanic	CAR/ NAT/EUR intra- and inter-regional main traffic flow
	North America – Eastern Caribbean	New York, Miami, Havana, San Juan, Santo Domingo, Piarco	High-density oceanic	West Atlantic Route System CAR/NAM inter-regional traffic flow

Chapter 4: Air Traffic Management (ATM)

4.1 Introduction

4.1.1 The general purpose of ATM, according to the Global ATM Operational Concept, is to achieve an inter-functional global air traffic management system for users during all flight phases that meets agreed operational safety levels, provides optimum operations, is environmentally sustainable and fulfils national security requirements.

4.1.2 The future system should evolve from the current system in such a way that user requirements are met as fully as possible, according to clearly-established operational requirements. The fact is that the most difficult problems ATM system designers must resolve are transition and integration. It is virtually impracticable to evolve from one system to another over a period of less than several years.

4.1.3 The design of the airspace structure should not be restricted by airspace boundaries and divisions. Planning should be coordinated between adjacent areas in order to achieve a continuous airspace in which the user will not perceive any divisions. That airspace should be free from operational discontinuities and inconsistencies and should be organised to meet the needs of different types of users when the time comes. Transition between areas should be seamless to users at all times.

4.1.4 Planning and implementation of ATM Operational Concept components should include study of their impact on and requirement for human resources.

4.1.5 Some benefits to be expected from implementation of these components are enhanced safety, lower operating fuel costs for users, less delays and gas emissions and an increase in system capacity.

4.1.6 Air traffic management evolution in the CAR/SAM Regions has been carefully planned to avoid degradation of current system performance. It is necessary, as progressive improvements are made in air navigation efficiency throughout the transition period, to ensure at least the present operational safety level. Aircraft should not be unnecessarily burdened with the need to carry a multiplicity of CNS equipment, both existing and new, over the lengthy transition cycle.

4.2 General principles

4.2.1 All States, Territories and International Organisations in the CAR/SAM Regions should be guaranteed unrestricted access to the air navigation services covered by this document.

4.2.2 It is recognised that CAR/SAM States need to comply fully with national plans and with standards governing use of the new systems.

4.2.3 States should accept the global nature of the ATM operational concept and have the firm intention to facilitate the integration mechanisms needed for its timely implementation.

4.2.4 CNS infrastructure should be carefully planned in accordance with the identified requirements for an appropriate level of air traffic management in the CAR/SAM regions.

4.2.5 CNS elements should be introduced progressively in the light of the benefits they will provide to the ATM community.

4.3 Implementation strategy

4.3.1 ATM evolution for the CAR/SAM Regions has been planned taking into account the GPIs that could be implemented in the short and medium term. These Initiatives will be applied to the main international traffic flows identified in homogeneous areas as well as in the main terminal areas and will produce operational benefits for the ATM community. The ATM Evolution Tables not only set forth the necessary requirements for ATM improvements, but also specify the implementation dates for planned improvements, together with performance goals and the main GPI implementation tasks.

4.4 ATM evolution in the CAR/SAM Regions

4.4.1 General

4.4.1.1 ATM evolution is based on Global Plan Initiatives applied to:

a) Air operations in general

b) En-route operations; and

c) TMA operations

4.4.2 Air operations in general

4.4.2.1 This portion of the Plan includes Global Plan Initiatives that are applied to air operations in general that cannot be considered en-route and/or TMA operations.

*Note: Tables on ATM evolution in the CAR/SAM Regions – Air operations in general - can be found in **Appendix 1** to this chapter.*

4.4.2.2 Flexible use of airspace (FUA)

4.4.2.2.1 Strategic coordination and dynamic interaction will facilitate an optimum, balanced and equitable civil/military use of airspace, which, in turn will permit the establishment of optimum flight paths, while reducing operational costs for airspace users.

4.4.2.2.2 CAR/SAM States, Territories and International Organisations should establish policies on the use of temporary or permanent restricted airspace in order to avoid, as much as possible, the adoption of airspace restrictions, particularly on a permanent basis.

4.4.2.2.3 The first step in the process of implementing the Flexible Use of Airspace should be to evaluate dangerous, restricted and prohibited airspaces that impede or that could prevent aircraft flow.

4.4.2.2.4 The establishment of letters of agreement between ATS units and military units or other users for the dynamic and flexible use of airspace should eliminate restrictions on airspace use, thus making it possible to accommodate the needs of all airspace users.

4.4.2.2.5 Where airspace restriction is unavoidable, the letters of agreement should stipulate that the blockage will last no longer than necessary. In such cases, other paths should be developed for the dynamic re-routing of aircraft to enable them to avoid those airspaces.

4.4.2.2.6 Those paths should then be published in the AIPs to warn users of the need to consider said deviations in their flight planning.

4.4.2.2.7 FUA implementation involves convincing military authorities of the States involved that their needs will be met, independently of the application of airspace restrictions. It will, therefore, be necessary to hold seminars/meetings with those authorities to demonstrate the importance of optimised airspace use.

4.4.2.2.8 FUA implementation will meet the following performance objectives:

a) Safety: Flexible use of airspace will avoid the need for deviations in airspace for special use, as well as the resulting concentration of air traffic on particular routes. This will make it possible to reduce controller workload and the likelihood of air traffic conflicts.

b) Capacity: Augmenting the airspace available for civil aviation use and reducing the controller workload will increase airspace capacity.

c) Cost-effectiveness: Use of optimum flight paths will improve aircraft operator cost-benefit ratios. The relatively low cost involved and the reduction of controller workload will produce an improvement in ANSP cost-effectiveness because of the smaller investments that will be needed in infrastructure.

d) Efficiency: The provision of optimum flight paths as a result of the expansion of available airspace will make it possible to reduce aircraft flying time, promote efficient fuel consumption and reduce operating costs in general, thus improving environmental conditions through the reduction of harmful gas emissions into the atmosphere.

4.4.2.3 **Air traffic flow management**

4.4.2.3.1 The application of timely demand and capacity balancing measures will avoid overburdening the ATM system and provide the necessary conditions for maximising the use of airport and ATC capacity. This will significantly increase airspace capacity and enhance operational efficiency.

4.4.2.3.2 Inasmuch as air traffic congestion and saturation problems in the CAR/SAM Regions are still very specific, the application of air traffic flow management measures should start gradually to allow States, Territories and International Organisations to gain experience, particularly in calculating and maximising ATC and airport capacities.

4.4.2.3.3 The implementation of ATFM in the CAR/SAM Regions should take into account the objective and principles established in Appendix AL to Item 3 of GREPECAS/13, stressing that ATFM measures should foster maximum use of existing capacity without jeopardising safety. Furthermore, it is important to emphasise that AFTM measures should not be used to resolve the occasional deficiencies intrinsic to the ATM system.

4.4.2.3.4 In this way, AFTM will be implemented by stages in the CAR/SAM Regions, in response to established operational requirements. These stages are:

a) Strategic airport implementation

b) Tactical airport implementation

c) Strategic airspace implementation

d) Tactical airspace implementation

e) Centralised implementation

<u>Strategic airport ATFM</u>

4.4.2.3.5 Normally, the adoption of strategic flow management measures in airports located in low traffic density airspace avoids the congestion and saturation of that airspace. Another aspect to be considered is that it is easier to implement strategic ATFM measures in airports because they require less extensive data collection on flight intent (RPL, Official Airline Guide (OAG), flight plans, etc.) and the use of existing computer and infrastructure tools.

4.4.2.3.6 The authorities which establish appropriate regulations to standardise the use of airports slots in the concession of airports to private entities, in order to keep a close coordination for slots management.

4.4.2.3.7 The first step in implementing ATFM in the CAR/SAM Regions should be to establish a common methodology for calculating airport capacity that would make it possible to identify airports where demand exceeds capacity during certain periods. Once these airports have been identified, measures could be taken to optimise use of the existing capacity.

4.4.2.3.8 Strategic ATFM measures in airports should be limited to the use of airport slots for the purpose of ensuring a balance between the demand for scheduled flights and airport capacity. Slot implementation would ensure hourly flight distribution at airports.

4.4.2.3.9 Therefore, procedures should be developed to distribute airport slots among operators with scheduled flights in accordance with predicted airport saturation/congestion. It is also necessary to consider the capacity required to accommodate other airspace users (non-scheduled flights).

<u>Tactical airport ATFM</u>

4.4.2.3.10 ATFM measures in airports should evolve toward the inclusion of non-scheduled flights in demand and capacity balancing procedures. While the implementation of ATFM tactical measures at airports today is not yet complex, it would still require expanding the data collection programme on flight intent to include FPLs and the utilisation of an efficient means of communication between airport operators that conduct non-scheduled flights and FMUs or FMPs, as well as the use of existing computer and infrastructure tools.

4.4.2.3.11 ATFM tactical measures in airports will continue to be limited to the use of airport slots. Even so, airport demand and capacity balancing would also take non-scheduled flights into consideration. At this stage, procedures for airport slot allocation among operators should also consider non-scheduled flights.

4.4.2.3.12 Strategic airport measures are expected to be enough to resolve specific problems at airports with a significant demand for scheduled flights, while tactical measures would be applied only at airports where there are a significant number of non-scheduled flights

Strategic airspace ATFM

4.4.2.3.13 Based on the experience acquired in airport demand and capacity management, the States, Territories and International Organisations should consider making airspace studies, particularly of those where airport ATFM measures alone are unable to resolve problems of congestion and saturation. These strategic ATFM measures should eliminate airspace congestion and saturation. Implementation of these measures would not be very complex, because it would involve only their impact on the establishment of airport slots. It would, however, require the use of more sophisticated computer and infrastructure tools to permit the analysis of air traffic movements in each portion of airspace in order to identify congestion or saturation in control sectors.

4.4.2.3.14 Scheduled flights would be considered in demand and capacity balancing. Airport slot distribution procedures in this stage should take into account airport and airspace saturation/congestion forecasts.

4.4.2.3.15 Strategic airspace ATFM measures are expected to be sufficient to avoid the overloading of control sectors, particularly in airspace with a significant demand for overflights.

Tactical airspace ATFM

4.4.2.3.16 During this ATFM implementation stage, the States, Territories and International Organisations should proceed to the most complex phase, which involves tactical ATFM airspace measures that include dynamic procedures applicable to flights to be carried out within a few hours. The adoption of tactical airspace measures would be highly complex because it would involve applying ATC slots based on the results of continuous demand/capacity analysis. This analysis would call for the use of more sophisticated computer and infrastructure tools than those employed in the previous stage in order to allow for assignment of ATC slots to prevent airspace and airport overloading.

4.4.2.3.17 It is expected that tactical airspace ATFM will be implemented only in States, Territories and International Organisations where there is a clearly-defined operational requirement, bearing in mind that the complexity of such measures would be very costly in terms of automated systems, databases, telecommunication system and training of human resources.

4.4.2.3.18 States, Territories and International Organisations that decide to implement tactical airspace AFTM should develop the applicable ATFM standards, procedures and operating manuals.

Centralised ATFM

4.4.2.3.19 Most States, Territories and International Organisations are expected, when centralised ATFM becomes available, to implement tactical airspace ATFM by making the relevant institutional arrangements and considering the most favourable cost-benefit ratio.

4.4.2.3.20 In order to provide Air Traffic Flow Management (ATFM) service, the centralised ATFM in the CAR and SAM Regions should perform the following activities:

a) Set up and maintain a database in the region where it operates, regarding:

- ✓ air navigation infrastructure, air traffic service (ATS) units and registered aerodromes
- ✓ relevant ATC and airport capacity; and
- ✓ data on foreseen flights

b) Establish a coherent table of predicted traffic demand, its comparison with available capacity and determination of critical traffic overload zones and durations foreseen;

c) Coordinate as needed to increase the available capacity where necessary;

d) When deficiencies in available capacity cannot be eliminated, determine and duly implement ATFM measures where needed, coordinated beforehand with interested aircraft operators and aerodromes;

e) Monitor the outcome of the measures implemented;

f) Coordinate ATFM service with the other centralised ATFM units where needed.

Performance objectives

4.4.2.3.21 ATFM implementation will aim to accomplish the following performance objectives:

a) Safety: ATFM implementation will avoid the overloading of the ATM system, thereby enhancing or maintaining current safety levels.

b) Capacity: By keeping the ATM system free from overload, ATFM will provide the necessary conditions for appropriate aircraft flow, thereby enhancing system capacity.

c) Cost-effectiveness: ATFM will avoid aircraft flight delays and optimise capacity use, thus enhancing the cost-effectiveness of aircraft operators. Maximum capacity use will, furthermore, improve ANSP cost-effectiveness by reducing investment in infrastructure.

d) Efficiency: Maximum use of ATC and airport capacity will allow for improvement of aircraft flight profiles, fostering efficient fuel consumption and a reduction of operating costs in general, resulting in an environmental improvement through the reduction of harmful gas emissions into the atmosphere.

4.4.3 En-route operations

4.4.3.1 ATM evolution for en-route operations took into account the main GPIs applicable to the CAR/SAM Regions and was planned in such a way as to permit optimum airspace management and organisation.

4.4.3.2 Homogeneous areas and main continental and oceanic traffic flows were taken into account and an ATM evolution table was prepared for each.

Note: ATM evolution in the CAR/SAM Regions – En-route operations **-** *is to be found in* ***Appendix 2*** *to this chapter.*

4.4.3.3 Implementation of performance-based navigation

4.4.3.3.1 Implementation of PBN will foster use of advanced aircraft navigation capabilities which, when combined with air navigation infrastructure, will make it possible to optimise the airspace, including the route network. This, in turn, will contribute to the establishment of an ATS routing environment that meets the needs of airspace users and reduces controller and pilot workload and aircraft concentration in portions of the airspace.

4.4.3.3.2 PBN implementation for en-route operations will require establishing exclusionary airspaces because they offer the conditions for making the necessary changes in airspace structure. The vertical boundaries of the airspace where PBN is to be implemented should be thoroughly analysed, in order not to exclude a large number of users.

Short term

4.4.3.3.3 No major changes are expected in the existing airspace structure, given the low density of air traffic in the oceanic airspaces. The sole exception will be the application of RNP-10 in the region known as WATRS, which will require a significant change in airspace structure in the CAR Region. No changes are expected in the short term in airspaces where RNP-10 (EUR/SAM Corridor, Lima-Santiago de Chile routes and South Atlantic Random Route System) is applied.

4.4.3.3.4 It is expected that RNAV-5 will be implemented in selected continental airspaces where operational benefits can be obtained and the existing CNS infrastructure is capable of supporting its use.

Medium term

4.4.3.3.5 It is expected that RNP-4 will be applied in the EUR/SAM Corridor and in the Santiago de Chile/Lima route segment, with the utilisation of ADS/CPDLC to permit a 30 NM lateral and longitudinal separation. Materialisation of this application will depend upon the evolution of the aircraft fleet operating in these airspaces.

4.4.3.3.6 It is expected that in this phase RNP-2 will be applied in selected continental airspaces, with the exclusive use of GNSS, since the ground infrastructure will not support RNAV. It will be necessary to establish a GNSS back-up system and develop contingency procedures for the possible failure of the GNSS. RNP-2 implementation will facilitate PBN application in airspaces without ATS surveillance service. Exclusive GNSS use will mean that the GNSS signal will need to broadcast more information.

Performance objectives

4.4.3.3.7 PBN implementation for en-route operations will aim to achieve the following performance objectives:

a) Safety: Optimisation of the airspace structure will make it possible to reduce air traffic concentration in portions of the airspace and crossing points. In the oceanic airspace, increasing the number of parallel routes will foster air traffic distribution, avoiding its concentration. The reduction of air traffic concentration will improve safety.

b) Capacity: Reducing lateral separation and controller workload will help increase airspace capacity.

c) Cost-effectiveness: Establishment of harmonized criteria for aircraft and operator approval will help limit the number of operating approvals in use. Using the navigation capacity already installed in most of the aircraft flying in the upper airspace will improve the cost-benefit ratio of aircraft operators. The relatively low cost involved and the reduction of controller workload will, in turn, bring about an improvement in ANSP cost-effectiveness because it will lead to a reduction of investment in infrastructure.

d) Efficiency: Provision of an optimum airspace structure will make it possible to reduce aircraft flying time, thereby contributing to efficient fuel consumption and a reduction of operating costs in general, resulting in improved environmental conditions through the reduction of harmful gaseous emissions into the atmosphere.

4.4.3.4 Situational awareness and implementation of data link applications

4.4.3.4.1 ADS-C and CPDLC application in oceanic airspaces will promote the necessary conditions for use of 30 NM horizontal separation minima in the EUR/SAM Corridor and in the Santiago de Chile/Lima route segment. Furthermore, in other oceanic airspaces with less air traffic density, ADS-C and CPDLC will provide reliable means of surveillance and communication, thereby reducing controller and pilot workload.

4.4.3.4.2 Application of improved surveillance techniques (ADS-B and/or multilateralism) in continental airspace will make it possible to reduce horizontal separation minima, improve safety, increase capacity and improve flight efficiency profitably. Use of other data link applications instead of voice communications offers significant advantages in terms of safety and pilot and controller workload.

4.4.3.4.3 These benefits can be obtained by providing surveillance in areas not equipped with primary or secondary radars, when justified by cost-benefit analysis. In airspaces where radar is used, improved surveillance can enhance the quality and reliability of surveillance information both on the ground and in the air. States, Territories and International Organisations should make a consistent cost-benefit analysis to determine whether when the time comes for PSR and/or SSR systems to be replaced, it would be desirable to replace them with ADS-B systems or multilateralism.

4.4.3.4.4 CPDLC use in continental airspace with high traffic density should be evaluated, considering that the characteristics of ATC interventions could make it unviable.

4.4.3.4.5 Gradual implementation of ATS inter-facility data communication (AIDC) will improve airspace safety and reduce coordination errors between ATS units.

4.4.3.4.6 In implementing ATS surveillance systems and data link applications, consideration should be given to the corresponding aspects of automation, particularly the need to harmonise the systems applied in order to ensure their interoperability.

4.4.3.4.7 Furthermore, ATM automation tools (minimum safe altitude warning; conflict prediction; conflict alert; conflict resolution advisory; path conformance control; functional integration of ground systems with aircraft systems, etc.) should also be considered when implementing ATS surveillance systems and data link applications.

Performance objectives

4.4.3.4.8 Improvements in ATS surveillance services and the implementation of data link applications for en-route operations aim to achieve the following performance objectives:

a) Safety: The application of data link will make it possible to improve ATS surveillance service and will reduce the use of speech communications, thereby reducing the workload of pilots and controllers and improving safety.

b) Capacity: Airspace capacity will be increased by reducing horizontal separation and controller workload.

c) Cost-effectiveness: Utilisation of appropriate surveillance systems and data link-based communications will enable airspace users to employ optimum flight profiles, thereby improving the cost-benefit ratio of aircraft operators. Replacing PSR and SSR with ADS-B or multilateralism systems could improve ANSP cost-effectiveness, considering that these measures would bring about a reduction of investment in infrastructure.

d) Efficiency: Applying optimum flight profiles will lead to efficient fuel consumption and a reduction of operating costs in general, resulting in improved environmental conditions, due to the reduction of harmful gases emissions into the atmosphere.

4.4.4 TMA operations

4.4.4.1 Evolution of air traffic management in terminal areas should be harmonised with ATM evolution for en-route operations, making it possible to obtain a harmonious and integrated ATM system.

4.4.4.2 ATM evolution for TMA operations took account of the combination of different GPIs applicable to the CAR/SAM Regions and was planned to allow for optimum airspace management and organisation.

4.4.4.3 The table on the Optimisation of TMA structure combined GPIs 5, 10, 11 and 12, all of which concern the optimisation of TMA airspace structure, using SIDs and STARs based on RNAV-, RNP- and/or FMS based approach procedures, as well as application of TMA design and management techniques and the functional integration of ground and on board systems.

4.4.4.4 The table referring to situational awareness and data link application combined GPIs 9 and 17 in view of the close relationship between the application of improved surveillance techniques (ADS-B and/or multilateralism) and the use of data link applications.

4.4.4.5 Many elements must be taken into account in planning the requirements for an air navigation service infrastructure in a TMA. In addition to traffic volume, other factors to be considered include, *inter alia*, the number and location of aerodromes, traffic characteristics, topography, meteorological conditions, etc. Consequently, States, Territories and International Organisations should be responsible for studying each TMA in particular and determining, in coordination with users, the requirements for implementing the corresponding air navigation services.

Note: The tables on ATM evolution in the CAR/SAM Regions – Operations in terminal areas (TMAs) - can be found in ***Appendix 3*** *to this chapter.*

4.4.4.6 <u>Optimisation of TMA structure</u>

4.4.4.6.1 The following measures will optimise TMA airspace structure:

a) Implementing PBN, including SIDs and STARs with RNP and RNAV, and RNP approach procedures.

b) Functional integration of ground and on board systems.

c) Using improved design and management techniques.

4.4.4.6.2 <u>Implementation of performance-based navigation</u>

4.4.4.6.2.1 TMA operations have unique features because of the separation minima applicable between aircraft and between aircraft and obstacles. All aircraft are involved, including low-performance aircraft that fly in the lower airspace and use the same or nearby paths for their arrival and departure procedures as those of high-performance aircraft.

4.4.4.6.2.2 In this sense, States/Territories and International Organisations need to develop their own national plans for implementing PBN in TMAs, based on the CAR/SAM PBN Road Map. An effort will be made to harmonise aircraft separation criteria and applicable RNAV and/or RNP criteria, to avoid the need to obtain multiple approvals for intra- and inter-regional operations.

4.4.4.6.2.3 The efficiency with which TMA operations are carried out in a PBN environment will depend upon Aerodrome Design and Management (GPI 13) and Runway Operations (GPI 14), inasmuch as the airport infrastructure will have to absorb any increase in air traffic flow in TMA operations.

Short term

4.4.4.6.2.4 RNAV-1 is expected in TMAs selected by the States, in environments equipped with ATS surveillance and appropriate ground navigation infrastructure that will permit the performance of DME/DME and DME/DME/INS operations. Both equipped and non-equipped aircraft will be allowed to operate during this phase and once a suitable percentage of approved air operations have been reached, RNAV-1 operations should be started.

4.4.4.6.2.5 RNP-1 application is expected in TMAs selected by the States, where there is no ATS surveillance service and/or appropriate ground navigation infrastructure, with exclusive application of GNSS, provided that there are a suitable percentage of approved air operations. Even so, when the corresponding operational benefits are confirmed, both approved and not approved aircraft will be allowed to operate. Whether overlay or exclusive RNP procedures are applied will depend upon air traffic complexity and density.

4.4.4.6.2.6 RNP 0.3 (basic GNSS) approach procedures are expected in as many airports as possible, particularly those where international flight operations are conducted, while not-equipped aircraft will continue to use conventional approach procedures.

4.4.4.6.2.7 RNP AR approach procedures are also expected in airports where their operational benefits are evident because of the existence of significant obstacles.

Medium term

4.4.4.6.2.8 During this phase, the expansion of RNAV or RNP 1 application is expected in TMAs selected by States, depending upon the ground infrastructure and aircraft navigation capabilities. RNAV or RNP 1 equipment will be mandatory in the more complex TMAs (exclusionary airspace), while in the less complex TMAs the operations of equipped and non-equipped aircraft will still be allowed.

4.4.4.6.2.9 The expanded application of RNP 0.3 and RNP AR procedures is expected in selected airports during this phase. The application of the GLS procedure is also expected to start, which will improve the transition from the TMA to the approach phase, basically using the GNSS for both phases.

4.4.4.6.3 Functional integration of ground and on board systems

4.4.4.6.3.1 States, Territories and International Organisations are expected to study the feasibility of using functional integration of ground and on board systems, with a view to apply flight procedures that provide the most efficient trajectory during approach of an aircraft to the destination aerodrome. These procedures shall enable an un-interrupted flight trajectory from the beginning of the descent until the aircraft is stabilized for the landing.

4.4.4.6.3.2 The optimization of efficiency in TMAs shall depend of the major possible use of automation. Also, in addition to the application of the continuous descent capacities, aircraft shall be each time more equipped with calculation in arrival time. This capacity shall be integrated with ground automated systems, in order to identify fixed flight schedules. These schedules should assist in the landing sequence process enabling aircraft to stay near their 4D preferred trajectory.

4.4.4.6.4 The use of improved design and management techniques

4.4.4.6.4.1 Airspace planners should apply design techniques to TMA restructuring, in order to:

a) Validate the proposed airspace structure.

b) Evaluate the impact of implementing PBN, including RNAV and/or RNP SID and STAR procedures, RNP approach procedures and FMS-based arrival procedures, using ATC simulations where necessary.

c) Ensure a favourable cost-benefit ratio.

d) Optimise sectorisation to make it seamless to users and balanced in terms of workload.

4.4.4.6.4.2 To improve TMA management, consideration should be given to implementing the WGS-84 and taking measures to optimise air traffic management and capacity, including a collaborative decision-making process involving the tower, TMA and en-route sectors, while strategically encompassing airspace users.

Performance objectives

4.4.4.6.5 TMA structure optimisation is aimed at achieving the following performance objectives:

a) Safety: Optimisation of TMA structure will enhance safety by making it possible to design independent arrival and departure sectors, provide a "natural" separation between aircraft and reduce the workload of pilots and controllers.

b) Capacity: Reducing lateral separation and the workload of controllers will foster an increase in airspace capacity.

c) Cost-effectiveness: Establishment of harmonised criteria for aircraft and operator approval will help limit the number of operational approvals in use. The utilisation of the navigation capacity already installed in most aircraft will improve the cost-benefit ratio of aircraft operators. The cost to ANSPs is relatively small.

d) Efficiency: Providing an optimum airspace structure will allow aircraft flying time to be reduced, favouring efficient fuel consumption and a reduction of operating costs in general. This will result in improved environmental conditions due to the reduction of harmful gaseous emissions into the atmosphere.

4.4.4.7 **<u>Situational awareness and implementation of data link applications</u>**

4.4.4.7.1 In addition to the considerations set out in paragraph 4.4.3.4, which are also applicable to TMA operations, the States, Territories and International Organisations should consider the following aspects when implementing ATS surveillance services and data link applications in the TMA:

4.4.4.7.2 The implementation of improved surveillance techniques (ADS-B and/or multilateralism) in TMAs will permit the integration of en-route and TMA operations.

4.4.4.7.3 The use of ATS surveillance systems (SSR, ADS-B and/or multilateralism), it will be possible to apply RNAV-based navigation techniques without having to rely on RNP because that surveillance will allow the monitoring of flights in order to detect any possible deviation from their path. Thus, users that would not be approved for RNP operations could be included in TMA operations.

4.4.4.7.4 Implementation of improved surveillance techniques would facilitate the operation of aircraft without RNAV/RNP approval because it would allow controllers to route them through vectors up to their final approach.

4.4.4.7.5 CPDLC is not expected in TMAs, given the characteristics of ATC intervention in these airspaces. Data link applications, such as D-ATIS and digital flight plan clearances (DCL), however, will reduce the workload of controllers and pilots.

4.4.4.7.6 The fact that TMA users may not be equipped with data link systems must be considered, given that a large number of low-performance aircraft fly in this airspace and may not have the capacity to be properly equipped. In that case, procedures should be developed to permit the flight of unequipped aircraft, unless the air traffic density justifies use of exclusionary airspaces.

<u>Performance objectives</u>

4.4.4.7.7 The implementation of improvements in ATS surveillance services and of data link applications for TMA operations will be aimed at achieving the following performance objectives:

a) Safety: The implementation of data link will improve ATS surveillance service and reduce the use of speech communications, thus reducing the workload of pilots and controllers and enhancing safety.

b) Capacity: Reducing horizontal separation and controller workload will contribute to an increase in airspace capacity.

c) Cost-effectiveness: Use of appropriate surveillance systems and of data link-based communications will make it possible for airspace users to utilise optimum flight profiles, improving the cost-benefit ratios of aircraft operators. ANSP cost-effectiveness could be enhanced by replacing PSR and SSR by ADS-B or multilateralism systems, since these would lead to a reduction of investment in infrastructure.

d) Efficiency: Application of optimum flight profiles will foster efficient fuel consumption and reduce operating costs in general, resulting in improved environmental conditions due to the reduction of harmful gaseous emissions into the atmosphere.

Appendix 1 to Chapter 4

EVOLUTION OF AIR TRAFFIC MANAGEMENT IN THE CAR/SAM REGIONS
AIR OPERATIONS IN GENERAL

GPI 1 – Flexible use of airspace		
Related GPIs	Not applicable	
Homogeneous Areas involved	All	
Description of ATM improvement	Optimum, balanced and equitable civil/military use of airspace, facilitated by strategic coordination and dynamic interaction, will permit the establishment of optimum flight paths while reducing operational costs for airspace users.	
Performance objectives	**Safety**	Flexible use of airspace will avoid deviations in airspace for special use, and the resulting concentration of air traffic on particular routes. This will make it possible to reduce controller workload and the probability of air traffic conflicts.
	Capacity	Increasing airspace availability for civil aviation use and reducing controller workload will increase airspace capacity.
	Cost-effectiveness	Use of optimum flight paths will improve aircraft operator cost-benefit ratios. The relatively low cost involved and the reduction of controller workload will improve ANSP cost-effectiveness because of the smaller investments in infrastructure that will be needed.
	Efficiency	The provision of optimum flight paths as a result of the expansion of available airspace will make it possible to reduce aircraft flying time, thus favouring efficient fuel consumption and reducing operating costs in general, with the resulting improvement of environmental conditions due to the reduction of harmful gaseous emissions into the atmosphere.
On board requirements	Not applicable.	
Ground requirements	Not applicable.	
Critical aspects to be considered	FUA implementation involves convincing military authorities of the States involved that their needs will be met, independently of the application of airspace restrictions. It will, therefore, be necessary to hold seminars/meetings with those authorities to demonstrate the importance of optimised airspace use.	
Other aspects to be considered	The flexible use of airspace will depend upon the establishment of procedures between airspace users and ATS or ATFM units, with a view to dynamically applying airspace reservation to certain users	

	only when necessary.
Main tasks	✓ Establish policies on the use of transitory or permanent restricted airspace. ✓ Evaluate dangerous, restricted and prohibited airspace that affect or might affect air traffic flow. ✓ Establish a letter of agreement between ATS units and military units or other users.
Date of implementation	**2010**

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GPI 6 – Air traffic flow management (ATFM)		
Related GPIs	Not applicable	
Homogeneous areas involved	**All**	
Description of ATM improvement	The application of timely demand and capacity balancing measures will prevent overloading the ATM system and will provide the necessary conditions for maximising the use of airport and ATC capacity. This should significantly increase airspace capacity and improve operational efficiency	
Performance objectives	**Safety**	ATFM implementation will prevent overloading the ATM system, thereby enhancing or maintaining current safety levels.
	Capacity	By keeping the ATM system free from overload, ATFM will provide the necessary conditions for appropriate aircraft flow, thereby enhancing system capacity.
	Cost-effectiveness	ATFM will avoid aircraft holding and optimise capacity use, thus enhancing the cost-effectiveness of aircraft operators. Maximum capacity use will, furthermore, improve ANSP cost-effectiveness by bringing about a reduction of investment in infrastructure.
	Efficiency	Maximum use of ATC and airport capacity will allow for improvement of aircraft flight profiles, fostering efficient fuel consumption and a reduction of operating costs in general, resulting in improved environmental conditions due to the reduction of harmful gaseous emissions into the atmosphere.
On board requirements	Not applicable	
Ground requirements	Database containing information about: ✓ planning and processing of flight plans (FPL, RPL, etc.); ✓ airspace and airport structure; ✓ display of the aeronautical situation; ✓ automatic messages to support decision-making (access to SLOTS, reporting of delays, alternate routes, etc.); ✓ monitoring the operational status of air navigation infrastructure; ✓ capacity of the airport acceptance regime (AAR); ✓ ATC capacity; ✓ air traffic demand; ✓ airspace structure and ATS route network;	

	✓ navigation aids, radar, etc.; aircraft performance;	
Critical aspects to be considered	Centralised ATFM implementation will generically encompass all issues related to technical, operational, administrative, financial and legal matters that must be taken into account when considering the establishment of multinational facilities.	
Other aspects to be considered	Because it is an entirely new activity for most States, ATFM implementation should be evolutionary to permit them to gain experience with simpler demand and capacity balancing procedures carried out at airports, until they are able to dynamically undertake a complete analysis of airspace overload.	
Main tasks	✓ System capacity analysis ✓ Cost-benefit analysis ✓ Coordinate with industry and with national and international organisations ✓ Establish the infrastructure and database ✓ Train human resources ✓ Develop standards and procedures ✓ Monitor system performance	
Date of implementation	**Strategic airport AFTM**	**2008**
	Tactical airport ATFM	**2009**
	Strategic airspace ATFM	**2010**
	Tactical airspace ATFM	**2011**
	Centralised ATFM	**2012**

Appendix 2 to Chapter 4

EVOLUTION OF AIR TRAFFIC MANAGEMENT IN THE CAR/SAM REGIONS EN-ROUTE OPERATIONS

GPI 5 – Implementation of Performance-Based Navigation (PBN) Continental Airspace		
Related GPIs	GPIs 5, 7, 10, 11, 12, 20 and 21	
Homogeneous areas involved	AR1, AR3 and AR5	
Description of ATM improvement	Implementation of PBN will foster use of advanced aircraft navigation capabilities which, when combined with air navigation infrastructure, will make it possible to optimise the airspace, including the route network. This, in turn, will contribute to the establishment of an ATS routing environment that meets the needs of airspace users and reduces controller and pilot workload and aircraft concentrations in airspace portions.	
Performance objectives	**Safety**	Optimisation of the airspace structure will make it possible to reduce air traffic concentration in portions of the airspace and crossing points.
	Capacity	Reducing lateral separation and controller workload will help increase airspace capacity.
	Cost-effectiveness	Establishment of harmonised criteria for aircraft and operator approval will help limit the number of operational approvals in use. Using the navigation capacity already installed in most of the aircraft flying in the upper airspace will improve the cost-benefit ratio of aircraft operators. The relatively low cost involved and the reduction of controller workload will, in turn, bring about an improvement in ANSP cost-effectiveness since it will lead to a reduction of investment in infrastructure.
	Efficiency	Provision of an optimum airspace structure will make it possible to reduce aircraft flying time, thereby contributing to efficient fuel consumption and a reduction of operating costs in general. This will result in improved environmental conditions due to the reduction of harmful gaseous emissions into the atmosphere.

On board requirements	RNAV-5	✓ RNAV capacity ✓ RNAV- 5 approval ✓ VHF voice or data DCPC
	RNP-2	✓ RNAV capacity ✓ RNP-2 approval ✓ VHF voice or data DCPC
Ground requirements	RNAV-5	✓ RNAV-5 publication ✓ VHF voice or data DCPC ✓ ground-ground speech or AIDC COM ✓ appropriate navigation and surveillance infrastructure
	RNP-2	✓ RNP-2 publication ✓ voice or data DCPC ✓ ground-ground speech/AIDC COM
Critical aspects to be considered	PBN implementation depends upon the capacity of aircraft operators to meet airworthiness requirements and, furthermore, on the results of the cost-benefit analysis and the relevant safety assessments.	
Other aspects to be considered	The efficiency of en-route operations in a PBN environment will depend upon Terminal Area Design and Management (GPI 10), the use of RNAV STARs/SIDs (GPI 11), Aerodrome Design and Management (GPI 13) and Runway Operations (GPI 14), considering that TMAs and aerodromes must absorb any increases in traffic flow in en-route operations.	
Main tasks	✓ Cost-benefit analysis ✓ Safety assessment ✓ Coordinate with industry and with national and international organisations ✓ Modify automated ATC systems ✓ Aircraft and operator approval ✓ Develop standards and procedures ✓ Train controllers and pilots ✓ Monitor system performance	
Date of implementation	RNAV-5	2010
	RNP-2	2015

GPI 5 – Implementation of Performance-Based Navigation (PBN) Oceanic airspace		
Related GPIs	GPIs 5, 7, 10, 11, 12, 20 and 21	
Homogeneous areas Involved	AR2 and AR4	
Description of ATM improvement	Implementation of PBN will foster use of advanced aircraft navigation capabilities which, when combined with air navigation infrastructure, will make it possible to optimise the airspace, including the route network. This, in turn, will contribute to the establishment of an ATS routing environment that meets the needs of airspace users and reduces controller and pilot workload and aircraft concentrations in portions of the airspace.	
Performance objectives	**Safety**	An increase in the number of parallel routes in the oceanic airspace will foster the distribution of air traffic, avoiding its concentration. The reduction of air traffic concentration will, in turn, enhance safety.
	Capacity	Reducing lateral separation and controller workload llers will foster an increase in airspace capacity.
	Cost-effectiveness	Establishment of harmonised criteria for aircraft and operator approval will help limit the number of operational approvals in use. Using the navigation capacity already installed in most of the aircraft flying in the upper airspace will improve the cost-benefit ratio of aircraft operators. The relatively low cost involved and the reduction of controller workload will, in turn, bring about an improvement in ANSP cost-effectiveness because it will lead to a reduction of investment in infrastructure.
	Efficiency	Provision of an optimum airspace structure will make it possible to reduce aircraft flying time, thereby contributing to efficient fuel consumption and a reduction of operating costs in general. This will result in an improvement of environmental conditions, due to the reduction of harmful gaseous emissions into the atmosphere.
On board requirements	RNP-4	✓ RNP-4 approval ✓ ADS/C capacity ✓ CPDLC
Ground requirements		✓ RNP 4 publication

	RNP-4	✓ ADS/C capacity ✓ CPDLC ✓ ground-ground speech or AIDC COM ✓ ATM automation
Critical aspects to be considered	PBN implementation depends upon the capacity of aircraft operators to meet airworthiness requirements and, furthermore, upon the results of the cost-benefit analysis and the relevant safety assessments.	
Other aspects to be considered	The efficiency of en-route operations in oceanic airspace depends upon the route structure of adjacent airspaces and calls for close coordination with ICAO Regions adjacent to the SAM Region.	
Main tasks	✓ Cost-benefit analysis ✓ Safety assessment ✓ Coordinate with industry and with national and international organisations ✓ Modify automated ATC systems ✓ Aircraft and operator approval ✓ Develop standards and procedures ✓ Train controllers and pilots ✓ Monitor system performance	
Date of implementation	**RNP-4**	2015

GPI 9 – Situational awareness GPI 17 - Implementation of data link applications Continental airspace		
Related GPIs	GPIs 6, 7, 9, 17, 18, 19 and 22	
Homogeneous areas involved	AR1, AR3 and AR5	
Description of ATM improvement	Application of improved surveillance techniques (ADS-B and/or multilateralism) will make it possible to reduce horizontal separation minima, improve safety, increase capacity and improve flight efficiency profitably. Use of other data link applications instead of voice communications will offer significant advantages in terms of safety and pilot and controller workload.	
Performance objectives	**Safety**	Application of data links will make it possible to improve ATS surveillance service and will reduce the use of speech communications, thereby lessening the workload of pilots and controllers and increasing safety.
	Capacity	Reducing horizontal separation and controller workload will increase airspace capacity.
	Cost-effectiveness	Utilisation of appropriate surveillance systems and of data link-based communications will enable airspace users to employ optimum flight profiles, thereby improving the cost-benefit ratios of aircraft operators. Replacing PSR and SSR with ADS-B or multilateralism systems could improve ANSP cost-effectiveness, considering that these measures would bring about a reduction of investment in infrastructure.
	Efficiency	Applying optimum flight profiles will lead to efficient fuel consumption and a reduction of operating costs in general, resulting in improved environmental conditions due to the decrease in atmospheric emissions of harmful gases.
On board requirements	✓ ADS-B ✓ VHF or SSR data links ✓ GNSS ✓ CPDLC (if applicable in continental airspace)	

Ground requirements	✓ ADS-B/ VHF or SSR data links/ GNSS ✓ CPDLC (if applicable in continental airspace) ✓ AIDC ✓ ATM automation	
Critical aspects to be considered	ADS-B application should consider the interdependence of this functionality and the GNSS, inasmuch as the inoperability of either one would mean the loss of ATS surveillance. Contingency procedures should be developed to cope with such a situation.	
Other aspects to be considered	Use of operational data links should consider the human elements involved and take into account existing and future controller and pilot profiles.	
Main tasks	✓ Study the existing and planned ATS operational scenarios in which ADS-B and/or multilateralism; CPDLC and AIDC would be implemented ✓ Cost-benefit analysis ✓ Coordinate with industry and with national and international organisations ✓ Modify automated ATC systems ✓ Develop standards and procedures ✓ Train human resources ✓ Monitor system performance	
Date of implementation	**ADS-B**	**2010 to 2015**
	AIDC	**2010 to 2015**

<table>
<tr><td colspan="3">GPI 9 – Situational awareness
GPI 17 - Implementation of data link applications
Oceanic airspace</td></tr>
<tr><td>Related GPIs</td><td colspan="2">GPIs 6, 7, 9, 17, 18, 19 and 22</td></tr>
<tr><td>Homogeneous areas involved</td><td colspan="2">AR2 and AR4</td></tr>
<tr><td>Description of ATM improvement</td><td colspan="2">ADS-C and CPDLC application in oceanic airspaces will promote the necessary conditions for use of 30 NM horizontal separation minima in the EUR/SAM Corridor and in the Santiago de Chile/Lima route segment. Furthermore, in other oceanic airspaces with less air traffic density, ADS-C and CPDLC will provide reliable means of surveillance and communication, thereby reducing controller and pilot workload.</td></tr>
<tr><td rowspan="4">Performance objectives</td><td>Safety</td><td>Application of data links will make it possible to improve ATS surveillance service and will reduce the use of speech communications, thereby lessening the workload of pilots and controllers and improving safety.</td></tr>
<tr><td>Capacity</td><td>The reduction of horizontal separation and controller workload will contribute to increase airspace capacity.</td></tr>
<tr><td>Cost-effectiveness</td><td>Utilisation of appropriate surveillance systems and data link-based communications will enable airspace users to employ optimum flight profiles, thereby improving the cost-benefit ratios of aircraft operators.</td></tr>
<tr><td>Efficiency</td><td>Applying optimum flight profiles will lead to efficient fuel consumption and a reduction of operating costs in general, resulting in improved environmental conditions due to the reduction of atmospheric emissions of harmful gases.</td></tr>
<tr><td>On board requirements</td><td colspan="2">✓ ADS-C
✓ Satellite data link
✓ CPDLC</td></tr>
<tr><td>Ground requirements</td><td colspan="2">✓ ADS-C
✓ Satellite data link
✓ CPDLC
✓ AIDC
✓ ATM automation</td></tr>
<tr><td>Critical aspects to be considered</td><td colspan="2">Efficient application of ADS-C, CPDLC and AIDC must take into account the interdependence of systems existing in the ACCs responsible for adjacent airspaces, and calls for close</td></tr>
</table>

	coordination with the ICAO Regions adjacent to the SAM Region.	
Other aspects to be considered	Use of operational data links should consider the human elements involved and take into account existing and future controller and pilot profiles.	
Main tasks	✓ Study the existing and planned ATS operating scenarios in which ADS-C, CPDLC and AIDC would be implemented ✓ Cost-benefit analysis ✓ Coordinate with industry and with national and international organisations ✓ Modify automated ATC systems ✓ Develop standards and procedures ✓ Train human resources ✓ Monitor system performance	
Date of implementation	**ADS-C**	**2010**
	CPDLC	**2010**
	AIDC	**2010**

Appendix 3 to Chapter 4

EVOLUTION OF AIR TRAFFIC MANAGEMENT IN THE CAR/SAM REGIONS
TMA OPERATIONS

Optimisation of TMA structure		
GPIs involved	GPI 5 – Implementation of performance-based navigation (PBN) GPI 10 – Terminal area design and management GPI 11 - RNP and RNAV SIDs and STARs GPI 12 – FMS-based arrival procedures	
Related GPIs	GPIs 20 and 21	
Description of ATM improvement	The TMA airspace structure will be optimised to allow for optimum profile flights by taking the following measures: a) Implementing PBN, including RNP and RNAV SIDs and STARs and RNP approach procedures. b) Applying FMS-based arrival procedures. c) Using improved design and management techniques.	
Performance objectives	**Safety**	Optimisation of TMA structure will enhance safety by making it possible to design independent arrival and departure sectors, provide a “natural” separation between aircraft and reduce the workload of pilots and controllers.
	Capacity	Reducing lateral separation and the workload of controllers will foster an increase in airspace capacity.
	Cost-effectiveness	Establishment of harmonised criteria for aircraft and operator approval will help limit the number of operational approvals in use, while utilisation of the navigation capacity already installed in most aircraft will improve the cost-benefit ratio of aircraft operators. The cost to ANSPs of doing this is relatively small.
	Efficiency	Providing an optimum airspace structure will allow aircraft flying time to be reduced, promoting efficient fuel consumption and a reduction of operating costs in general, resulting in improved environmental conditions due to the decrease in harmful gaseous emissions into the atmosphere.
		✓ RNAV capacity

On board requirements	RNAV-1	✓ RNAV- 1 approval ✓ VHF voice DCPC
	RNP-1	✓ RNAV capacity ✓ RNP-1 approval ✓ VHF voice DCPC
	RNP 0.3 approach	✓ RNAV capacity ✓ GNSS ✓ RNP 0.3 approval
	RNPAR approach	✓ RNAV capacity ✓ GNSS ✓ RNP < 0.3 approval ✓ Special functionalities (radius to fix, RNP missed approach, etc)
	GLS approach	✓ RNAV capacity ✓ GNSS ✓ GLS approval ✓ GBAS receiver
Ground requirements	RNAV-1	✓ RNAV-1 publication ✓ VHF voice DCPC ✓ Ground-ground speech or AIDC COM ✓ Appropriate navigation and surveillance infrastructure ✓ SSR, ADS-B or multilateralism surveillance ✓ Flight inspection
	RNP-1	✓ RNP-1 publication ✓ Voice or data DCPC ✓ Ground-ground speech/AIDC COM ✓ Flight inspection
	RNP 0.3 approach	✓ RNP-0.3 publication ✓ Voice or data DCPC ✓ Ground-ground speech/AIDC COM ✓ Flight inspection
	RNPAR approach	✓ AR RNP publication ✓ Voice or data DCPC ✓ Ground-ground speech/AIDC COM ✓ Flight inspection
	GLS approach	✓ GLS publication ✓ Voice or data DCPC ✓ Ground-ground speech/AIDC COM ✓ GBAS ✓ Flight inspection
Critical aspects to be considered	PBN implementation depends upon the capacity of aircraft operators to meet airworthiness requirements and, furthermore, upon the results of the cost-benefit analysis and the relevant safety assessments.	
Other aspects to be considered	➢ The efficiency of TMA operations in a PBN environment will depend upon aerodrome design and management (GPI 13)	

	and runway operations (GPI 14), inasmuch as aerodromes will have to absorb any increase in air traffic flow in TMA operations. ➢The impact on controller workload and on safety of applying a non-exclusionary airspace in TMAs to allow for the flight of non-RNAV and/or -RNP approved aircraft should be analysed.	
Main tasks	✓ Cost-benefit analysis ✓ Safety assessment ✓ ATC simulation exercises ✓ Coordinate with Industry and with National and International Organizations ✓ Modify automated ATC system ✓ Aircraft and operator approval ✓ Develop standards and procedures ✓ Train controllers and pilots ✓ Monitor system performance	
Implementation date	RNAV-1	2010
	RNP-1	2010 to 2015
	RNP 0.3 approach	2010
	RNP AR approach	2010 to 2015
	GLS approach	2015

GPI 9 – Situational awareness GPI 17 - Implementation of data link applications		
Related GPIs	GPIs 6, 7, 9, 17, 18, 19 and 22	
Description of ATM improvement	Application of improved surveillance techniques (ADS-B and/or Multilateralism) will make it possible to optimise TMA operations. Implementing improved surveillance techniques (ADS-B and/or multilateralism) in TMAs will offer the necessary conditions for integration of en-route and TMA operations. Use of data links for ATIS and flight plan clearance will reduce controller and pilot workload.	
Performance objectives	**Safety**	Data link applications will improve ATS surveillance service and cut down on the use of speech communications, thus reducing the workload of pilots and controllers and enhancing safety.
	Capacity	Reducing horizontal separation and the controller workload will contribute to an increase in airspace capacity
	Cost-effectiveness	Use of appropriate surveillance systems and of data link-based communications will make it possible for airspace users to utilise optimum flight profiles, improving the cost-benefit ratios of aircraft operators. ANSP cost-effectiveness could be enhanced by replacing PSR and SSR by ADS-B or multilateralism systems because these would lead to a reduction of investment in infrastructure.
	Efficiency	Application of optimum flight profiles would foster efficient fuel consumption and reduce operating costs in general, resulting in improved environmental conditions due to the reduction in harmful gas emissions into the atmosphere.
On board requirements	✓ ADS-B capacity ✓ VHF or SSR data links ✓ GNSS	
Ground requirements	✓ ADS-B ✓ VHF or SSR data links ✓ GNSS ✓ AIDC ✓ ATIS-D ✓ DCL ✓ ATM automation	

Critical aspects to be considered	ADS-B application should consider the interdependence of this functionality and the GNSS, inasmuch as the inoperability of either one would mean the loss of ATS surveillance. Contingency procedures should be developed to cope with such a situation.	
Other aspects to be considered	Use of operational data links should consider the human elements involved and take into account existing and future controller and pilot profiles.	
Main tasks	✓ Study the existing and planned ATS operational scenarios in which ADS-B and/or multilateralism; CPDLC and AIDC would be implemented ✓ Cost-benefit analysis ✓ Coordinate with industry and with national and international organisations ✓ Modify automated ATC systems ✓ Develop standards and procedures ✓ Train human resources ✓ Monitor system performance	
Date of implementation	**ADS-B**	**2010 to 2015**
	AIDC	
	ATIS-D	
	DCL	

Chapter 5: Communications

5.1 Introduction

5.1.1 CAR/SAM States, Territories and International Organisations should, when implementing communications systems, consider the operational requirements set out in Chapter 4 of this Plan.

5.1.2 Implementation of communications systems in the CAR/SAM Regions should be planned considering GPIs 22 and 23 and bearing in mind the functionalities that could be implemented in the short and medium term.

5.1.3 Consideration should be given, in the evolution of the aeronautical mobile and fixed communications infrastructure, to applying voice and data communications so that that infrastructure can adapt to the new functions and offer the appropriate service capacity and quality to support ATM requirements.

5.1.4 Communications systems should be implemented based on the results of cost-benefit analyses of the different scenarios available, by comparing the existing structure with the improvements to be obtained if the new systems are implemented. Two or more technologies that meet the same operational requirement should also be studied.

5.1.5 Implementation of the communication systems in the short and medium term should give consideration to the established operational requirements that would meet future ATM expectations, using the following tools, among others:

a) Aeronautical message handling system (AMHS).

b) Very high frequency digital link (VDL).

c) Satellite digital link.

d) Air traffic services interfacility data communications (AIDC).

e) Controller-pilot data link communication (CPDLC).

5.1.6 Communications systems planning should still take into consideration the necessary communications required to effectively support centralised air traffic flow management as regards:

a) Other centralised ATFM systems

b) FMUs, FMPs and/or ATS units involved

c) Operators and users

d) Airport authorities

e) Meteorological authorities

f) Aeronautical information services

g) Radar and ADS data transmission for ATFMC

5.1.7 Implementation of communications systems should be based on a harmonised strategy for the CAR/SAM Regions, taking into account operational requirements and relevant cost-benefit analyses. It should, furthermore, be based on Action Plans to ensure that CAR/SAM States, Territories and International Organisations implement the necessary systems in keeping with consistent timescales.

Planning details for the implementation of communication systems – CNS COMMITTEE

Chapter 6: Navigation

6.1 Introduction

6.1.1 CAR/SAM States, Territories and International Organizations should, when implementing navigation systems, consider the operational requirements set out in Chapter 4 of this Plan.

6.1.2 Implementation of navigation systems in the CAR/SAM Regions should be planned considering GPI 21 and take into account the functionalities that could be implemented in the short and medium term.

6.1.3 Consideration should be given, in the evolution of navigation infrastructure, to technologies that provide the appropriate service capacity and quality for supporting ATM requirements.

6.1.4 Navigation systems should be implemented based on the results of cost-benefit analyses of the different scenarios available, by comparing the existing structure with the improvements to be made if the new systems are implemented. Two or more technologies that meet the same operational requirement should also be studied.

6.1.5 Implementation of the navigation systems in the short and medium term should give consideration to the established operational requirements that would meet future ATM expectations, taking into account, *inter alia,* the following aspects:

a) The ground navigation infrastructure needed for the operations envisioned in the CAR/SAM PBN Road Map.

b) Application of the GNSS for en-route operations without the use of precision values, together with RNAV-5 (continental airspaces) and RNP-4 (oceanic airspaces).

c) Application of the GNSS for TMA operations (RNAV 1).

d) Application of the GNSS for approach operations (RNP 0.3, RNP AR and GLS).

e) The need to apply the SBAS to meet the requirements of the CAR/SAM PBN Road Map.

c) The cost-benefit analysis of SBAS use, bearing in mind the effects of the implementation of GALILEO and of frequency L5 in the GPS.

6.1.6 Implementation of navigation systems should be based on a harmonised strategy for the CAR/SAM Regions that would take into account the operational requirements and relevant cost-benefit analyses. It should, furthermore, be based on Action Plans to ensure that CAR/SAM States, Territories and International Organisations implement the necessary systems in keeping with consistent timescales.

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Planning details for the implementation of navigation systems – CNS COMMITTEE

Chapter 7: Surveillance

7.1 Introduction

7.1.1 CAR/SAM States, Territories and International Organisations should, when implementing surveillance systems, consider the operational requirements set out in Chapter 4 of this Plan.

7.1.2 Implementation of surveillance systems in the CAR/SAM Regions should be planned considering GPIs 9 and 17 and bearing in mind the functionalities that could be implemented in the short and medium term.

7.1.3 Consideration should be given, in the evolution of surveillance infrastructure, to technologies that provide the appropriate service capacity and quality for supporting ATM requirements.

7.1.4 Surveillance systems should be implemented based on the results of cost-benefit analyses of the different scenarios available, by comparing the existing structure with the improvements to be made if the new systems are implemented. Two or more technologies that meet the same operational requirement (*e.g.* ADS/B or multilateralism) should also be studied.

7.1.5 Implementation of surveillance systems in the short and medium term should give consideration to the established operational requirements that would meet future ATM expectations, using the following tools, among others:

a) ADS-B

b) ADS-C

c) Multilateralism

d) SSR

e) The combination of the cited tools.

7.1.6 Implementation of surveillance systems should be based on a harmonised strategy for the CAR/SAM Regions that would take into account the operational requirements and relevant cost-benefit analyses. It should, furthermore, be based on Action Plans to ensure that CAR/SAM States, Territories and International Organisations implement the necessary systems in keeping with consistent timescales.

Planning details of the implementation of surveillance systems – CNS COMMITTEE

Chapter 8: Meteorology

8.1 Introduction

8.1.1 CAR/SAM States, Territories and International Organizations should, when implementing meteorological systems, consider the operational requirements set out in Chapter 4 of this Plan.

8.1.2 Implementation of meteorological systems in the CAR/SAM Regions should be planned considering GPI 19 and bearing in mind the functionalities that could be implemented in the short and medium term.

8.1.3 The improvement of the world area forecasting system (WAFS), the international airways volcano watch (IAVW) and the ICAO tropical cyclone warning system will contribute to airspace optimisation by improving the precision, timely distribution and usefulness of the information developed by those systems. At the same time, by increasing the use of data links for transmitting meteorological information through uplinks and downlinks to help in the automatic sequencing of aircraft for their approach procedure, capacity will be maximised.

8.1.4 The global ATM system requires immediate access to world meteorological information in real time. These strict requirements will demand the automation of most meteorological systems. The automatic downloading, by means of downlinks, of MET data included in ADS messages will provide precise information about upper wind fields and wind profiles in real time. Increasing use should be made of data links to transmit information about meteorological conditions to aircraft by means of uplinks during approach and departure procedures, including the application of the data link-automatic terminal information service (D-ATIS) and D-VOLMET.

8.1.5 These improvements will give ATC units display access to precise upper wind fields both in the form of WAFS world upper wind forecasts and wind fields and wind profiles "in real time," derived from wind information automatically transmitted by aircraft through the automatic dependent surveillance (ADS) system and reports and forecasts of hazardous meteorological conditions, particularly volcanic ash, tropical cyclones, storms, clear air turbulence, icing and wind shear. This information will help ATM make tactical decisions for aircraft surveillance, air traffic flow management and flexible and dynamic aircraft routing and will contribute to the optimisation of airspace use.

Planning details of the implementation of meteorological systems – MET Subgroup

Chapter 9: Aeronautical Information Services

9.1 Introduction

9.1.1 CAR/SAM States, Territories and International Organisations should, when implementing Aeronautical Information Services, consider the operational requirements set out in Chapter 4 of this Plan.

9.1.2 Implementation of Aeronautical Information Services in the CAR/SAM Regions should be planned considering GPI 18, taking into account the functionalities that could be implemented in the short and medium term.

9.1.3 ATM, RNAV, RNP and FMS requirements introduced the need for corresponding new AIS requirements to ensure the quality and timely distribution of the information. In order to be able to provide information and meet these new requirements, the traditional aeronautical information service function will become an information management service, modifying its obligations and responsibilities.

9.1.4 Real-time quality electronic data (aeronautical information about the terrain and obstacles) is needed to facilitate coordination, enhance efficiency and safety and ensure that the different members of the ATM community possess the same information when they make collaborative decisions. By equipping aircraft with geographical reference data sets containing information for the en-route, terminal and aerodrome phases, pilots will have enhanced situational awareness during those operations, thanks to electronic data. The same information can be provided at different ATC positions and pre-flight planning units, and airline flight planning departments or general or private aviation users can have access to it. Electronic data can be adapted and their format modified to meet the requirements of ATM users and adjust to its applications. Standard data formats will be used to create databases into which data sets of an assured quality will be entered.

Planning details of the implementation of aeronautical information services – AIS/MAP Subgroup

Chapter 10: Aerodromes and Ground aids / Aerodrome Operational Planning

10.1 Introduction

10.1.1 CAR/SAM States, Territories and International Organisations should consider the operational requirements set out in Chapter 4 of this Plan when undertaking Aerodrome Operational Planning, including Ground Aids.

10.1.2 Aerodrome operational planning in the CAR/SAM Regions should be undertaken considering GPIs 13 and 14, taking into account the functionalities that could be implemented in the short and medium term.

10.1.3 The efficiency of TMA operations in a PBN environment will depend upon aerodrome design and management (GPI 13) and runway operations (GPI 14), inasmuch as aerodromes will have to absorb any increases in TMA air traffic flow.

10.1.4 Aerodrome operational planning should consider use of simulation tools to ensure the efficiency of runway and apron operations. To foster integrated design and management, it is also necessary to consider the use of combined airport and airspace simulations.

10.1.5 Activities to improve design and management, including coordination and collaboration among ATM service providers, vehicle operators and aircraft operators, can have an important impact on safety and aerodrome capacity.

10.1.6 Local collaborative decision-making should seek the sharing of key data on flight scheduling, so that all participants (aerodromes, ATC, ATFM, aircraft operators, and ground service providers) will have a more precise knowledge of aircraft status throughout the entire process. This would permit the adoption of minimum and precise ATFM measures and make flight scheduling more predictable. Some of the benefits to be obtained include a more efficient use of aerodrome and ground service resources, reduction of delays and greater predictability of flight schedules.

10.1.7 As an integral part of the air navigation system, the aerodrome must provide ground infrastructure including, among others, lights, taxiways, landing and departure runways and surface precision orientation systems, in order to improve safety and maximise the airport capacity in any weather condition. The ATM system must permit the efficient use of the airport infrastructure, in order to ensure the optimum use of airports, through the following actions:

a) runway occupation time must be reduced, where efficiency and capacity benefits may be obtained

b) ensure the execution of safe manoeuvres in any weather condition, in order to maintain VMC and IMC capacity

c) where necessary, surface precision orientation systems from/to the runway shall improve capacity and efficiency.

d) The position (with the appropriate precision level) and intentions of all vehicles and aircraft operating in the movement and manoeuvring areas must be known and available for the ATM community members in those aerodromes where it is possible to obtain a cost-benefit relationship showing a significant increase in the capacity and efficiency.

10.1.8 The first step in improving runway operation performance is to establish runway capacity reference values, which are usually defined as the maximum number of flights for which an aerodrome can provide routine services in one hour of operations with meteorological minima superior to Category I. These reference values are calculations that vary according to the runway configurations and combination of aircraft types involved. The goal should be the most appropriate use of aircraft capabilities and available runways to bring the number of all-weather operations as close as possible to the number of operations under visual meteorological conditions.

10.1.9 Reaching optimum capacity for each runway is a complex task that encompasses many factors, both tactical and strategic. In order to perform this task effectively, it is essential to gauge the effects of the changes and to monitor the performance of airspace users and ATM providers. Pilot and controller performance analysis would be applied in the latter case, recognising the need to maintain the trust of users and to work within the existing safety culture. A system of performance indicators should be designed to serve as the basis for taking the measurements and performing the analyses. Flight operations and ATM factors are among the tactical elements that affect runway occupancy. The aspects relating to flight operations include operator performance, effects of company procedures, use of airport infrastructure and issues of aircraft performance.

10.1.10 Limitations in runway capacity are defined by the procedures, the design of the surface area, aircraft performance capabilities, surveillance capability, aircraft spacing and meteorological limitations. Application of improved procedures to minimise spacing, such as the application of reduced runway separation minima, precision runway monitoring (PRM) and RNP and RNAV approaches for parallel runways not far from one another, will optimise spacing capacity.

Details of Aerodrome Operational Planning – AGA/AOP Subgroup

Chapter 11: Development of Human Resource Training requirements

11.1 Adequate provision of Air Navigation Services will depend upon the training of technical and operational personnel, together with their availability in large enough numbers to handle the different services.

11.2 Introducing ATM Operational Concept components will have a major impact on aeronautical personnel, both ground personnel and flight crews. For that reason, training is one of the key elements for a successful transition.

11.3 In the past, aeronautical technologies evolved gradually and instructors were generally able to meet the challenges created by change, even though they did not always have refined training methodologies and instruments available. The new CNS/ATM systems, however, are based on many new concepts that affect all areas of air navigation services and for that reason their implementation poses an even more serious challenge for instructors.

11.4 Many aeronautical disciplines will be modified as a result of the introduction of ATM Operational Concept components and it is likely that new training will be needed for several of these disciplines. The most important changes appear to have resulted form the need for a greater use of computers, data communications and automation.

11.5 New aeronautical disciplines will emerge with the introduction of ATM Operational Concept components. It will be necessary, from the viewpoint of human resource planning, to redistribute and train personnel.

11.6 The plans to study and complexity of the different disciplines has increased in such a manner that it deserves implementation of a professional status within the educational framework of States.

11.7 The need for training and course preparation will be especially strong during the transition stage. Not only will a large number of personnel have to be recycled or trained in new technologies, equipment and procedures, but a large enough number of skilled personnel will have to maintain their competence in the necessary skills to keep the older systems running and in good repair.

11.8 In planning the training of human resources for the implementation of the ATM Operational Concept components, it will be necessary to keep the specific requirements of each of the implementation activities in mind. An example that can be used are the PBN training requirements that involve airspace planning activities, design of air navigation procedures, airspace safety assessment, aircraft and operator approval and controller and pilot training.

11.9 Training planning in the CAR/SAM Regions should be handled at two duly coordinated levels. The first is GREPECAS, through the Human Resources and Training Subgroup (HRT/SG) and the second are the Civil Aviation Training Centres, where the necessary courses would be taught in a coordinated manner to avoid duplicating efforts.

Planning details of the implementation of communication systems – Human Resources and Training Subgroup (HRT/SG)

Chapter 12: Institutional Aspects

12.1 Introduction

12.1.1 CAR/SAM States, Territories and International Organisations should, when analysing the institutional aspects involved in implementing the ATM Operational Concept components, consider the operational requirements set out in Chapter 4 of this Plan.

12.1.2 In analysing those institutional aspects, consideration should be given to the information set forth in appendices C, D, E, F, G and H of the Global Air Navigation Plan.

12.1.3 Regional planning should take into consideration the characteristics intrinsic to ATM Operational Concept components, the impact of whose facilities may transcend national boundaries, making it necessary to implement multinational facilities to avoid duplication of resources and services. In establishing multinational facilities, the institutional aspects involved, which generically encompass all technical, operational, administrative, financial and legal matters, should be taken into account.

12.1.4 In view of the aspects cited in the previous paragraph and the need to develop a suitable structure for the planning and implementation of multinational facilities, the establishment of Regional Multinational Organisations is to be expected. These bodies, made up of groups of States, would guarantee optimum use of the investments needed to implement and maintain air navigation services.

Details of the institutional aspects involved in the implementation of the ATM operational concept components – Institutional Aspects Task Force