THIRD MEETING OF THE ALLPIRG/ADVISORY GROUP

(Montreal, 6 – 8 April 1999)

Agenda Item 5.5: Interregional coordination and harmonization mechanism – Interregional extension of the pilot project on CNS/ATM implementation

INTERREGIONAL EXTENSION OF THE PILOT PROJECT ON CNS/ATM IMPLEMENTATION

(Presented by the CAR/SAM CNS/ATM SIP Consultant)

1. INTRODUCTION

1.1 Conclusion 2/14 adopted by ALLPIRG/2 Meeting urged ICAO to develop a special implementation project (SIP) that would comprise implementation, on a trial basis and in the context of the work of the GREPECAS group, in the CAR/SAM Regions. With the Terms of Reference included in Appendix A to this working paper, the SIP was performed from July 1998.

1.2 In general terms, the consultant work consisted in developing a CNS/ATM planning methodology, elaborate guide line on business case and apply the methodology and the guide lines to one main traffic flow defined in the CAR/SAM Regions. Also, the consultant might propose a new scope and role for the PIRGs to emphasized the business like in the CNS/ATM implementation.

2. PLANNING METHODOLOGY

Objective

2.1 The planning of the transition to the CNS/ATM systems defined by ICAO is, in fact, the greatest enterprise which the aeronautical community must undertake, because of the magnitude that the change means for all the interested groups, manufacturers of aircraft and land systems associated with air navigation, air carrier operators, air traffic services providers, and perhaps for the development and evolution of satellite systems, both those for determination of position and for communications and surveillance.

2.2 The planned schedule for the transition, has suffered delays caused by various factors, such as the delay in the implementation of a world navigation satellite system, the lack of definition with respect to the financing of the new systems, and determination of legal responsibilities.

2.3 On the other hand, air operators do not have the necessary judgement elements to decide on investment in new systems required for the CNS/ATM, because the equipment, systems and their cost have

not yet been specified. It must be considered that the construction of new aircraft takes a certain time, therefore the requirements for the incorporation of new systems must be done well in advance. The modification of the current fleet, which has a high cost in equipment as well as in time, will only be accepted if the modernization benefits in terms of its utility are evident.

2.4 With regard to service providers, there has not been a common action in all the regions. The cost-benefit studies have not been carried out with equivalent methodologies, because they do not have the necessary capacity to conduct them or by lack of the required information for it.

2.5 In relation to the mentioned scenario, there exist different approaches to the CNS/ATM regional implementation projects, which, according to our understanding, is due to two reasons:

a) The demand is absolutely different between regions, for example, the demand in the CAR/SAM Region, is not comparable with the demand in Europe or North America.

b) The investment possibilities are absolutely different between the regions, both at level operators and at service providers level.

2.6 In these scenarios, it is clear that certain countries would not be willing to invest in the implementation of the CNS/ATM systems, unless the demand warrants it, and that they could receive a benefit for the different interested groups.

2.7 According to the foregoing, the methodology presented herein has the following objective:

"Provide a planning tool, applicable to the feasibility study of solutions door to door, in relevant traffic flows, within areas defined as homogeneous, and whose improvements benefit, from the operative and economical point of view, the users and as well as the service providers."

3. DEVELOPMENT OF THE METHODOLOGY

3.1 Previous information requirements:

a) traffic growth in a determined flow;

b) delays, or increase thereof, in the peak hours of a determined flow;

c) operators specific requirements; and

d) traffic growth forecasting by relevant flows and its future impact on the ATM efficiency.

3.2 The constant analysis of these indicators, which to date in many cases do not exist, and which is important to build in the future, will be the ones which in one way or another determine the need of applying a methodology like this to a flow study.

Evaluation of project need and opportunity

3.3 Experience indicates that it is necessary to make new investments in air infrastructure continuously in order to maintain and increase the rates of safety and availability, improve the quality of

service, and adjust opportunely the capacities of the systems to the growth expectations of the air traffic, that in the last decade has been permanently high.

Market analysis

3.4 The implementation criteria will try to satisfy the requirements derived from traffic growth forecasts in a determined route and also the users´expectations for more flexible service expectations and more efficient costs. However, in this case we point up the difference that exists in relation to this type of projects, developed by ICAO as well as by other ATM organizations, especially in Europe.

3.5 The reality of ICAO regions concerning air navigation is different. Consequently, the implementation criteria differ in many cases from those established, specially in the case of the CNS/ATM projects, because all of them have been carried out using airspace global concepts rather than regional or sector concepts.

3.6 In this case, in an intermediate region with certain sectors of low to average traffic, the main subject is still focused on the Safety of the Air Operations conducted in a defined route, and the need to increase the ATM system productivity and generate a greater capacity in these more busy areas.

Operators and suppliers requirements

3.7 In the specific case of the service providers, their requirements aim essentially to:

a) maintain or improve the current safety levels;

b) deliver a service to the satisfaction of their clients;

c) that its cost be entirely assumed by the users through a flexible tariffs system; and

d) that it permits a timely investment and returnable in prudential periods of time.

Periods of non-satisfaction of demand

3.8 In order to determine the actual use of the airspace included in a selected flow, it will always be necessary to carry out a detailed analysis of the existing air traffic and its forecasts. It is considered essential that all current or future business studies respond to real and pragmatically established requirements, in order to be able to define an effective costs study, which leads to an equitable and transparent distribution between providers and users.

Traffic forecasts

3.9 The required traffic growth forecast, is in terms of aircraft movement. However, it is difficult today to obtain that data directly, therefore, an indirect way has been determined through the statistics of passengers and freight traffic used as a dependent variable, and the GDP of each involved State, as an independent variable.

Technical analysis

3.10 This analysis must consider a knowledge and detailed evaluation of the current infrastructure of the route in the following aspects:

a) communications;

b) navigation;

c) surveillance;

d) ATM;

e) ATM data processing; and

f) human resources.

Cost-benefit analysis (CBA)

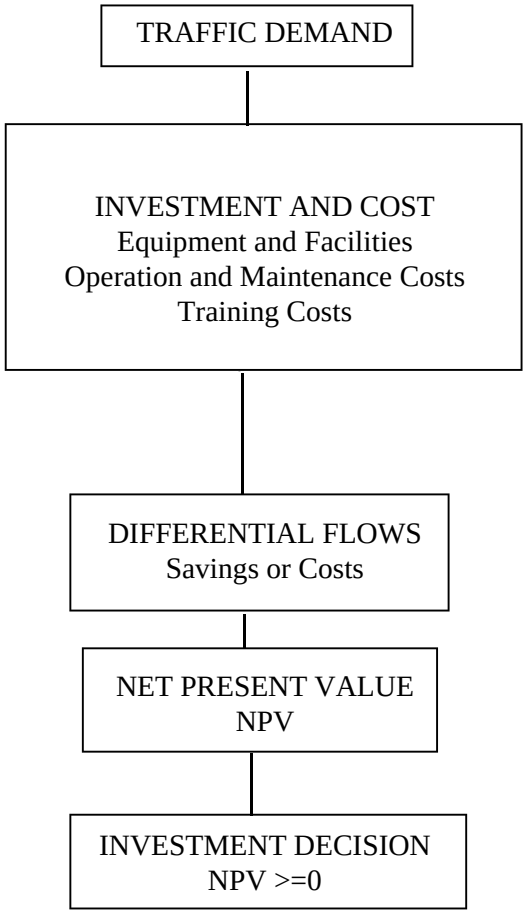
3.11 The cost-benefit analysis is an important tool in the evaluation of project options. A previous CBA evaluation for all the project options must be made in order to help to take the final decision with respect to a given course of action. It is important that the designated option 'base case" or "without project", is considered as a valid project alternative, since at all times it can result yet, the best action course.

Base case will mean the new investments, maintenance, operation and training costs which will have to incurred by both service providers and operators throughout the next years, in the event that the new regional CNS/ATM project were not implemented.

For *project case*, is meant the alternative that considers the investments, maintenance, operation and training costs which will have to incurred by both service providers and operators throughout the next years for regional implementation of CNS/ATM. In the event that due to technological reasons, deferred execution investments schedule, optimum moment of investing, etc., there exist investments and fund flows differentiated in the evaluation time, each of these situations should be considered as alternatives of the project case.

3.12 The methodology proposed in this work is based, in general terms, on the recommendations and basic guidelines contained in the ICAO Circular 257-AT/106. Therefore, it suggests the technique of projects evaluation known as NPV (Net Present Value), for the calculation of the cost-benefit relationship and considers the relevant differential costs of the base situation with respect to the situation of the project. These costs express the increase or decrease of the total costs that would imply the implementation of each one of the alternatives, in comparative terms with respect to the base situation. The principle underlying in this methodology is that only are relevant for the evaluation the costs that result from making the difference between the base situation and the investment alternative that is projected, that is to say, unavoidable costs are excluded, considering only those that have impact future.

3.13 The methodological scheme, for evaluating the perspective of both the providers of air navigation services and air operators is as follows:



Investments, costs and benefits

3.14 The investments in ground and airborne equipment for the base case, should consider the Region´s own investment plans, expressed in the Regional Plan of Air Navigation, as well as the plans at each State level. This equipment can be classified as follows:

COMMUNICATION	⇒	VHF HF DATA NETWORK
NAVIGATION	⇒	VOR DME NDB ILS
SURVEILLANCE	⇒	PSR SSR
ATM	⇒	UNIFIED ACCs

3.15 With respect to airborne equipment it should consider the avionics of new aircraft that are incorporated into the route and equipment corresponding to replacement of obsolete and amortized equipment.

3.16 The costs to be considered in the analysis are those corresponding to maintenance, operation and training. The benefits can be translated into costs saving by use of new technology and better use of

optimum flight profiles; in airspace capacity, allowing to meet to a greater demand, especially in cases of restrictions or congested routes and delays reduction.

4 BUSINESS STUDY

4.1 The objective of developing a Business Study is to demonstrate the viability of a project of ATM enhancement, transitioning to the new CNS technologies on the basis of a reasonable economic efficiency both for service providers and aircraft operators. It is important highlight the lack of appropriate statistical data in the FIRs involved in the main traffic flow under consideration, also the low support given by the States to provide information on their current air navigation services costs.

4.2 This study case was taken analyzing homogeneous areas and relevant flows of international traffic defined by the ATS Subgroup of the GREPECAS. It was decided to apply the Study to the case of relevant flow of international traffic between the following cities in the Region: Santiago, Lima, Guayaquil, Quito, Panamá, Kingston, Miami round trip. The business study, defined for a period of 15 years, considers the evolution of ATM by phases each aimed at partial operational objectives, determining costs and benefits for providers and users.

4.3 The objectives defined for the phases must respond to an actual need of improvement, with tangible benefits for the parties and that are not based just on the replacement of technologies considered old and whose obsolescence might be debatable. From this point of view, the statistical information becomes relevant for demand forecasting purposes and for defining future investment requirements in ATM and, consequently, in CNS. Therefore, the concept Homogeneous Areas and Main Traffic Flows separates implementation of CNS systems, choosing to begin the improvements in those spaces requiring them and deferring those sectors that, due to insufficient demand of services, warrant it.

Demand and supply of services

4.4 It is recognized that in the sector corresponding to the case under study, air traffic flows are low in comparison with other regions of the world. Consequently, its installed capacity does not suffer a significant crisis derived from unsatisfied demand. However, it is recognized the existence of deficiencies in communications, navigation and surveillance infrastructure in the region which can originate problems that could affect air safety. Also the first indications of routes saturation in peak hours have been detected.

Operators requirements

4.5 The information on the needs of the Region operators was obtained through two sources. One is the air carrier using the route more frequently and IATA's opinions in the regional environment. In both cases, the basic requirement for the flow is to obtain maximum efficiency in their flights, which means that service providers meet the growth demands by obtaining a greater capacity of airspace having the maximum possible amount of aircraft flying optimum flight profiles, speeds and flight levels, shorter routes, and recovering in a reasonable period the investment made.

Providers requirements

4.6 The States involved in the case are not supposed to grant subsidies to the sector. So the project from the point of view of the providers, must be specially careful in its cost-benefit analysis, bearing in mind that each required investment must be passed on to the user through air navigation tariff systems. We recognize that, at regional level, these systems have important deficiencies and very little transparency.

Development of options project

4.7 Information obtained from the market analysis indicate a non satisfied demand and a significant growth of traffic, which permits to envisage that the present incipient saturation situations, aggravated by the deficiencies in communications, navigation, surveillance and ATM detected in the technical analysis, will worsen and make the system collapse in the medium term: This makes it advisable to adopt opportunely the decision to continue with the development of the project.

Objectives of the study

4.8 According to the data obtained and the opinion of experts, the study has been defined with a 15 years horizon, considering the evolution of the ATM in three sequential phases having each partial operational objectives and establishing costs and benefits for providers and users. It was considerable an immovable condition that defined objectives for the three phases should respond to a real need of improvement, where the benefits are tangible, and that do not imply just the replacement of old technologies whose obsolescence might be debatable. From this point of view, the statistical information becomes relevant to forecast the demand and define the requirements of future investment in ATM and consequently in CNS technologies.

4.9 It has been decided to apply the concept of Homogeneous Areas and Main Flows of Traffic, choosing to apply the study to the flow previously defined. In the specific case of the flow selected, the first studies of traffic flow allow to assume that the optimization of the use of airspace, may be achieved applying the traditional separations with necessary technological innovations that make the reduction of separation possible. In this case, considering the requirements of providers and users, the need of establishing partial goals necessarily oriented to future navigation systems and that the investments that these projects require make them viable, it has been decided to achieve the following objectives, which in turn define the goals of this project:

OBJECTIVE Nº 1

"To apply 10 minutes or 80 nm of longitudinal separation, along the Santiago-Lima-Miami-Lima-Santiago and intermediate points of traffic merging"

OBJECTIVE Nº 2

"To apply 5 minutes or 40 NM of longitudinal separation, along the Santiago-Lima-Miami-Lima-Santiago and intermediate points of traffic merging"

OBJECTIVE Nº 3

"To apply radar separation and/or 1000 feet of minimum vertical separation above FL 290 along the Santiago-Lima-Miami-Lima-Santiago and intermediate points of traffic merging in accordance with rvsm project of ICAO"

4.10 With the above objectives it is intended to contribute to obtain many advantages in the ATM field, improving safety, reducing delays, increasing airspace capacity, increasing capacity and making the Control system more flexible. Whenever possible and with a view to facilitate the design of airspace, the planning process will be based more on a concept of area rather than on a fixed route.

4.11 The three scenarios defined in this project refer to a phased transition where it is possible to see an increase in operational benefits supported by an improvement in technical capabilities. In the case of the first objective -to reduce and regulate a minimum longitudinal separation of 10 minutes (80 NM) between aircraft of similar characteristics- the scenario makes intensive use of existing facilities both on the ground and airborne and its main concern is to achieve the objective at the minimum cost for both providers and users so that the operational benefit and consequently the economic benefit can be attained in the shortest term incorporating very basic elements of the CNS/ATM concept.

4.12 The second objective defines a similar scenario. However, this level of separation necessarily implies greater investments, both on the ground and airborne, which, in turn, derives in a significant increase in airspace capacity.

4.13 The third objective -application of a radar separation and/or minimum vertical separation of 1000 feet above FL290- basically implies to prepare providers and users for the implementation of this separation according to the progress concerning MSSR radar coverage en route and the directives that ICAO will publish concerning the RVSM project. Appendix B shows a detail of the ATM improvement and the required CNS elements.

Cost-benefit analysis

4.15 As explained in the Planning Methodology, the mechanism used to evaluate the economic convenience of choosing the base situation or with project, is based in the concept of present net value, in respect to the relevant differential costs of both situations, that is, in the updating of the probable future cash flows considered in each case, all this adjusted to a horizon of 15 years and a discount rate equivalent to 15%. In order to facilitate the comprehension of the results of the differential flows, firstly it has been considered the calculation of the present value of costs, that is, the updating of all the outcome flows of the project including the investment. This scheme which does not include the operation incomes of the base case or with project, allows to distinguish which project demands greater or smaller outcomes in relation to time, and the different sizes of investment required.

4.16 According to the proposed methodology scheme, only the costs of operation, certification and facilities, management and depreciation of fixed assets associated to the air navigation systems. In relation to the investment, has been considered the necessary equipment and facilities, in the concepts of Communications (VHF, HF, Data Network), Navigation (VOR, DME, NDB, ILS), Surveillance (PSS, SSR) and ATM (Unified ACCs), all of them valued at market prices and/or in accordance to the information provided by the supplier country. The operation costs and others have been estimated calculating predetermined rates established by the equipment manufacturer.

4.17 For practical reasons, it has not been considered in the attached calculations, the eventual residual values of the assets which could be object of sale, exchange or liquidation, matter that has a marginal character if measured in terms of income flow. According to the results of the evaluation of cost/benefit to the supplier and operator of Chile, we reached to the conclusion that the option of Project case is economically advantageous, since it results in net savings during the whole horizon of the project, demanding also, a smaller investment in relation to the base case.

5 CONCLUSION

5.1 The present business case, which has been established based on the operational needs of a relevant flow, shows the urgent need for reinforcing the regional and national planning in the economical aspects of the projects.

5.2 The way in which the regional planning has been structured through the Planning Groups (PIRGs) is emphasized. This is shown at initiating the cost-benefit study, since a broad and wide information of the evolutionary view that each group has developed for its corresponding region is available. The professionalism in the management of the airspace as well as the adequate administration of the available technologies is manifest. All of this structured in plans and programmes of easy comprehension for suppliers and the industry as well.

5.3 One of the mayor problems to apply the CNS/ATM planning methodology and carry out cost-benefits analysis on regional base, is the lack of the required air traffics statistics and costs information. The PIRGs should encourage the States to compile such information and do it available to the respective regional body.

5.4 Notwithstanding, it is also evident that except global methodologies based on general aspects and adopted rules and consensus, the cost-benefit component which would make operative those plans, has not been considered. The ALLPIRG decision of developing this type of methodology and the effort made in the CAR/SAM SIP, establish the need of the PIRGs to focus their efforts in:

a) Consolidate the concept that, in order that the plans and programs be viable, they should be prepared based on the management view of technological alternative and economical feasibility.

b) Incorporate experts in the areas of finance and economy, who might execute assessments of specific projects and be capable of sharing the global CNS/ATM and Flight Safety concepts.

c) These activities that should be included by the PIRGs shall lead to establish a flow of data committed with the business studies and some of them are not available in the Regions; whereas in others they will have to be organized.

d) The strong participation of the industry, which should provide basic information of operational costs, is foreseen, in order to achieve the goal of defining social and private profitability. This need requires to be proposed at a validation and transparent level of information, which would enable that these projects could be assessed by the international financing systems or those of the States, in similar conditions to other infrastructure and/or transport projects.

e) Finally, it is necessary that the PIRGs encourage the States to create their own CNS/ATM planning mechanism, including the economic factor, to enable their national plans to also reflect the structure of financiable projects by the economic community.

5.5 In compliance with ALLPIRG/2 Conclusion 2/14, in the sense of considering enhancements to the role and scope of the PIRGs, it can, now be considered that the activities of the SIP confirm and somehow validate the ALLPIRG/2 Conclusions 2/9 and 2/10 referring to the expansion of the role of the PIRGs and more emphasis on the business like planning approach of the same. It is therefore proposed that to be expanded the role and scope of the PIRGs including in its TOR the convenient wordings.

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APPENDIX A

TERMS OF REFERENCE

Terms of reference for the expert

1. Assist, as per guidelines to be provided by the ICAO Regional Offices in Lima and Mexico, in developing the outline of a regional planning methodology and identify a realistic target for its application and the development of an appropriate business case, including: background, ATM evolution, FIRs included, facilities and services on demand, CNS elements required, cost/benefit analysis, implementation options, potential financing sources, other related aspects, outputs.

2. With the orientation of ICAO Headquarters, define the criteria and methodology for the preparation of a business case.

3. Develop the draft business case project on the selected homogeneous ATM area or traffic flow, including: project effectiveness/rentability, investment possibilities, cost recovering possibilities, potential financing institutions, other related considerations.

4. Participate in a meeting with the GREPECAS CNS/ATM/IC Sub group to present the draft business case project.

5. With the comments and information received, prepare the draft business case project proposal.

6. Discuss the draft business case project proposal with the core co-ordinating team in ICAO HQ.

7. Co-ordinate the draft business case project proposal with the ICAO SAM Regional Office.

8. Terminate the preparation of the draft business case project proposal.

9. Submit the draft business case project proposal to the GREPECAS/8 meeting to be held in Dominican Republic.

10. With the comments and additional information received, prepare the final business case project proposal and the final report on the assignment.

11. Present the final documents to the ICAO SAM Regional Office.

12. Perform other related duties as required.

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APPENDIX B

ATM/CNS OBJECTIVES

1. OBJECTIVE Nº 1 for the year 2001

ATM

1.1 Considering that this first objective implies only a coordination of manual control procedures, which allow a 10 minutes longitudinal separation, ATM requirements must be limited accordingly. Considering the importance of a coordination between the different service providers it becomes indispensable to insure a link between ACCs that permits a highly reliable communication. For this purpose, it is necessary to update ground-ground data communications, AFTN network whether with the implementation of new technologies (AMHS communication gateways) or otherwise according to the convenience of the States involved. Also, given the concept of transition of this objective, it is advisable to implement, from this phase on, a concept of Air Traffic Flow Management (ATFM) based on manual procedures of coordination. This concept will gradually acquire more importance in the following phases.

1.2 The objective of the early implementation of ATFM is to ensure an optimum flow of air traffic to certain areas or through them during periods when the demand exceeds or is anticipated to exceed available capacity of the ATC system. Consequently, an ATFM system should reduce aircraft delays, both in flight and on the ground, and prevent an overload of the system.

1.3 The ATFM system will assist the ATC to achieve the objectives and obtain the most efficient utilization of available capacity of airspace. The ATFM should also ensure that air operations safety is not affected in the case of unacceptable levels of traffic congestion at the same time ensure that the traffic is managed efficiently without applying unnecessary restrictions to the flow.

Communications

1.4 Coverage of VHF frequencies at 25000 feet in FIR Santiago meets necessary requirements for the application of 10 minutes separation. This situation is partial in FIR Antofagasta, since the reliability is limited in the limits of FIR Lima. In FIR Lima it is expected that within a year and a half, through an integral project of communications, it will be under full VHF coverage. Concerning FIR Guayaquil, VHF coverage at 25000 feet is good. FIR Bogota, according to the information provided by the Aviation Authority of Colombia, is within acceptable parameters of coverage. For FIR Panama and FIR Kingston, at an altitude of 25000 feet an improvement must be considered in order to achieve a reliable coverage of 200 NM. FIR La Habana has complete VHF coverage, which overlaps with the VHF coverage of FIR Miami. Bearing in mind that the analysis shows that there are still some "gaps" where there is no VHF coverage, it is necessary the implementation of VHF (ER) equipment to cover the "gap" in the limit zone between FIR Antofagasta and Lima. Optionally, it is recommended the implementation by the providers of an HF Data Link station, capable of serving the whole route. This implies that the fleet must be equipped with compatible airborne systems.

Navigation

1.5 It is required that aircraft have B-RNAV capability and are ideally certified to maintain Required Navigation Performance (RNP-10). The 10 minutes separation in this flow implies application of Mach number techniques.

Surveillance

1.6 Present situation permits to envisage that surveillance will be provided both by manual control procedures and radar for those areas within radar coverage. For this purpose aircraft must be equipped with transponder.

2 **OBJECTIVE Nº 2 for the year 2008**

ATM

2.1 Separation procedures must consider the application of the Mach number technique.
Taking into account that longitudinal separation is reduced by a 50% as compared with previous objective, necessary coordinations between ACCs become more restrictive and require higher reliability. Consequently, for this phase, the operational functioning of the AFTM is mandatory.

Communications

2.2 It is required to implement direct communications Controller/Pilot in HF Data Link and/or communications via satellite. Consequently providers and aircraft must have this type of direct link on board.

Navigation

2.3 It is required to equip aircraft with capacity for navigating based on Area Navigation (B-RNAV) and, optionally, GPS plus Wide Area Augmentation. Aircraft must be certified to operate with RNP 4.

Surveillance

2.4 There are no specific surveillance requirements in this phase.

3 ***OBJECTIVE Nº 3 for the year 2014***

ATM

3.1 Considering that the part of the route without radar coverage corresponds to an end of the route, for which reason it will not have maximum traffic density, it is estimated that the application of combined radar/vertical separations, is a possible solution. Radar separation applicable on the route and hand over points between FIRs will be of 10 NM and 3 or 5 NM in TMAs, depending on minimums approved by each State. The exchange of data between facilities must be implemented prior to the application of this separation.

Communications

3.2 The achievement of previous objectives facilitates the achievement of objective 3. Consequently in this phase there are no new requirements, except those that could establish ICAO concerning RVSM implementation.

Navigation

3.3 The application of RVSM requires the implementation of P-RNAV or GPS plus RNAV.

Surveillance

3.4 As MSSR covers most of the route, leaving only an oceanic part uncovered, it is estimated that over a 90% of the route will have the possibility of applying radar separation.

– END –