

**International Civil Aviation Organization  
UNDP/ICAO REGIONAL PROJECT RLA/98/003  
Transition to the CNS/ATM Systems in the CAR and SAM Regions**

**STUDY OF THE MAIN AIR TRAFFIC FLOWS DEFINED IN THE REGIONAL PLAN –  
PHASE THREE AND PREPARATION OF PHASE IV**

**1. Introduction**

1.1 Project RLA/98/003 has, among other tasks, been in charge of the evaluation of each of the eighteen air traffic flows identified by GREPECAS and contained in the CAR/SAM Air Navigation Plan for the implementation of the CNS/ATM systems with a view to identify future requirements, propose technical and operational solutions and perform the necessary costs/benefits and sensitivity analysis to substantiate the evolutionary introduction of CNS/ATM facilities and services.

1.2 The activities for the analysis of the 18 flows were organized in four (4) Phases. The first three Phases, mainly related to the survey and analysis of the eighteen traffic flows, have been completed and work on Phase IV initiated.

**2. Phases I, II and III**

2.1 The result of the analysis carried out during Phases I, II and III established the base for the present and future requirements and will be used in the determination of technical and operational requirements.

2.2 The volume of air traffic and peak hours demands was established through surveys carried out at major reporting points on each of the flows. This information that contains scheduled and non-scheduled flights, also includes details on availability of preferred flight levels. The traffic volume for all major city pairs on the flow was cross-checked against the Official Airline Guide.

2.3 From the beginning, it was realized that airlines could have immediate benefits from the early introduction of RNAV routes and RNP values. The Appendix provides a summary of the savings that could be achieved as a result of the reduction of distances and major availability of preferred flight levels. To obtain the estimation of savings, assumptions had to be made in order to keep the evaluation process manageable and within the available time frame.

2.4 For some oceanic routes that are weather dependent, it was not possible to make a detail evaluation, but as a result of a study made in the North Atlantic for the FANS Committee, it was estimated that an efficiency improvement of 1.2% to 3% could be achieved. In order to keep the estimate conservative, 1.2% value has been used. It should be noted that all estimates have been reviewed to take into consideration price fluctuations and other elements affecting the cost of operations.

2.5 During Phase III a survey on the present status of human resources and training facilities has also been carried out with a view to evaluate the amount and the professional profiles of the personnel that will be required for the transition and subsequently the operation of

the new CNS/ATM systems and services. The result of the survey indicates that the staffing is, in many States, not enough even for the actual functioning and that immediate efforts will be necessary not only to assure additional personnel to cover actual requirements, but also for the new CNS/ATM systems, including the transition period, in which both conventional and new systems will be operated in parallel.

2.6 Attention is called to the need of ensuring that the new personnel professional profiles are adaptable to the new systems and procedures.

2.7 Although many States did not answer the survey, it was possible to establish an acceptable profile of:

- ATM personnel requirements and availability;
- ATM training centres available and future training requirements;
- Actual ACC infrastructure in the Regions; and
- CNS personnel requirements and availability.

2.8 Major effort is required in order to put into shape the personnel level along the different implementation phases and the project, as such, will update the information whenever necessary in order to provide more clarity in the planning process and assist in the determination of the personnel level and the related training resources.

### **3. Conclusion**

3.1 The evaluation of the traffic flows has been completed and, in every case, the introduction of RNAV routes and RNP values would provide immediate savings through reduced flying time and the capability to fly at preferred flight levels. Additionally, due to the traffic congestion experienced in some of the flows or part of them, the Reduced Vertical Separation Minima (RVSM) will need to be implemented to increase airspace capacity and allow more aircraft to fly at, or near, their preferred flight levels.

3.2 Phases I, II and III have also produced the necessary information to perform “Traffic Flow Profiles” to be used in the development of scenarios and “State Profiles” to be used in the planning and negotiations of the CNS/ATM transition steps with services providers and users, including the selection of technical and operational solutions, such as facilities and services to be used and the timing for their implementation.

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**ATTACHMENT**

**RESULTS OF THE STUDIES DURING PROJECT RLA/98/003 IMPLEMENTATION**

**1. Introduction**

1.1 The following paragraphs summarize the work carried out during the different phases of the study, the results obtained and, as necessary, the corresponding conclusions and recommendations.

**2. Phase I**

2.1 During the first phase of the study a methodology for the evaluation of the present and future traffic flows was developed. Furthermore, a work program to establish aircraft operating costs (per block hours) was established in order to evaluate operational savings resulting from more direct routes, as well as savings that could be made through the non-replacement of conventional nav aids.

2.2 In this phase of the study the flows: Buenos Aires/New York, Sao Paulo-Rio de Janeiro/Miami and Sao Paulo-Rio de Janeiro/New York were evaluated. These first flows were used as a test case in the validation of the analysis procedures.

**2.3 Conclusions y Recommendations**

2.3.1 As a result of the completion of the first phase of the study, it was evident that significant and immediate benefits could be made through the implementation of RNAV routes on the traffic flows analyzed. The estimated annual savings associated with the introduction of RNAV on the following routes amounted to:

<b>TF9</b>	<b>Sao Paulo, Rio de Janeiro/Miami</b>	<b>\$6,056,746.00</b>
<b>TF10</b>	<b>Sao Paulo, Rio de Janeiro/New York</b>	<b>\$2,284,511.00</b>
<b>TF11</b>	<b>Buenos Aires/New York</b>	<b><u>\$1,064,002.00</u></b>
<b>Total Phase I</b>		<b>\$9,405,259.00</b>

2.3.2 These savings, although impressive, are very conservative estimates of the potential savings, since the number of flights used in the calculation resulted from the surveys of traffic taken (July 99) only on the routes most frequently flown and are not adjusted for the busy month which is December.

2.3.3 As for long term projections, it will only be possible to quantify exactly the benefits and savings once the consolidation of all the requirements is completed (Phase IV) but nevertheless, preliminary estimates indicate that enormous savings can be achieved through the non-replacement of nav aids and, subsequently, their maintenance and calibration would not be

necessary. The amounts presented below do not take into consideration the minimum backup network of nav aids that might be necessary to protect against catastrophic failure of the satellite navigation systems. These figures will be refined as the project progresses. For the moment, it is estimated that in the CAR/SAM regions, the savings would amount to:

<b>Non-replacement of Nav aids</b>	<b>\$259,895,000.00</b>
<b>Maintenance/year</b>	<b>\$ 5,230,477.00</b>
<b>Inspection/calibration/year</b>	<b>\$ 13,640,000.00</b>

2.3.4 Taking into consideration the result of Phase I of the study and the immediate benefits that can be achieved, it was recommended that GREPECAS review the report and takes appropriate actions for the early introduction of RNAV routes and RNP values and make comments and recommendations on the results of this report with a view to make this study more responsive to the CNS/ATM planning process in the CAR/SAM Regions. In line with the above, co-ordinations with States have been undertaken and pre-operational trials initiated.

### **3. Phase II**

3.1 Phase II consisted in the evaluation of six traffic flows and the development of tools to facilitate the planning and decision process. These tools will enable the planners to develop different scenarios defining areas to be considered, select technical and operational solutions and implement the options envisaged. These scenarios will be subsequently processed through the Costs/Benefits Analysis (CBA) model to evaluate the viability of the scenario and then, through the Sensitivity Analysis (SA) program, determine which elements are critical in the implementation process. This exercise will also assist in the determination of the optimum implementation arrangements and implementation dates.

3.2 The set up portion of Phase II was made during April-May of 2000, the traffic survey on six of the flows conducted from 19 June to 2 July 2000 and the results were analyzed in October-November 2000. Once again, significant savings could be achieved through the introduction of RNAV routes.

3.3 The estimated savings resulting from reduced flying time (more direct routes) and reduced fuel-burn resulting from aircraft being able to fly more frequently at their preferred flight levels would be as follow:

<b>TF4</b>	<b>Sao Paulo, Rio de Janeiro/Europe</b>	<b>\$32,544,789.00</b>
<b>TF6</b>	<b>Santiago, Lima/Los Angeles</b>	<b>\$ 937,755.00</b>
<b>TF7</b>	<b>Santiago, Lima/Miami</b>	<b>\$ 4,544,254.00</b>
<b>TF8</b>	<b>Sao Paulo, Rio de Janeiro/Miami</b>	<b>\$ 3,650,202.00</b>
<b>TF12</b>	<b>Buenos Aires/Miami</b>	<b>\$ 6,087,665.00</b>
<b>TF15</b>	<b>Mexico, Dallas, Houston, Miami</b>	<b>\$ 5,336,999.00</b>
<b>Total Phase II</b>		<b>\$53,101,664.00</b>

3.4 Here again, except for the traffic flow between South America and Europe (TF4), the savings are considered conservative since June is not the busy month of the year and for the fuel-burn savings it has been assumed that only 20% of the flights would be performed at other than optimum flight level. Regarding TF4 mentioned above, the routes flown are not necessarily

direct routes, being dependent on weather conditions and traffic congestion in the European airspace. Therefore, the savings are only indicative.

3.5 During the same session and in preparation for Phase III, the main routes on the remaining nine traffic flows have been identified and surveys sent to States concerned. The survey, which includes 52 FIRs and some 31 checkpoints, has been carried out in January-February 2001 and the results were analyzed in May-June 2001.

### **3.6 Conclusions y Recommendations**

3.6.1 As a result of the completion of Phase II, it is recommended that the flows analyzed be also considered for the introduction of RNAV routes and RNP values and that GREPECAS reviews and comments on the development and utilization of the CNS/ATM Planning and Evaluation Tools (CNS/ATM PET) for the creation and evaluation of implementation scenarios in the CAR/SAM Regions.

## **4. Phase III**

4.1 During this Phase the documentation has been updated to reflect new developments, including details on the Planning and Review Process, assumptions used in formulations and sources for the data collected. These elements were documented to facilitate the comprehension of the report, provide an audit trail of the activities and process and, as necessary, permit the modification of assumptions made in the formulations or calculations. Additionally, the CNS/ATM PET has been further refined to include worksheets for data input, especially for items that are not database oriented such as ACC infrastructure or human resources.

4.2 In addition to the above, work has been initiated on Phase IV dealing with the consolidation of requirements and development of implementation scenarios. To this effect, preliminary information has been prepared on the sequence of the events related to the gradual implementation of CNS/ATM in the CAR/SAM regions. This sequence is now expressed as general steps that will be further elaborated.

4.3 During Phase III, work on staffing and training requirements for the new systems and its impact during and after the transition phase has also been initiated. To assist States in their planning process, a CNS/ATM Implementation Seminar (Bogota, Colombia, 10-14 September 2001) was carried out for the purpose of reviewing systems and services available including their implementation, operation and maintenance considerations and last, but not least, cost implications.

4.4 The traffic flow surveys have been conducted, during Phase III, on the remaining nine traffic flows (28 January to 10 February 2001) and the results analyzed during the months of April and May 2001. For most of the fixed routes the conventional methods of estimating savings have been used, but for the North South America/Europe (TF13), Mexico/Europe (TF14) and Central America/Europe (TF16) this methodology was not acceptable since most of the flight paths are weather dependent. Among the work accomplished by the Special Committee of the Council (FANS) a study was made over the North Atlantic to establish the financial benefits that could be derived from the transition to CNS/ATM. The result of the study indicated that through improved communications, coordination and ATM procedures, savings between 1.2% and 3% could be achieved. For the purpose of this study, the conservative value of 1.2% has been

retained for the estimation of the benefits. The estimated savings for the flows analyzed during Phase III are as follows:

<b>TF1</b>	<b>Santiago/Buenos Aires/Montevideo</b>	<b>\$ 3,148,568.00</b>
<b>TF2</b>	<b>Buenos Aires/Sao Paulo/Rio de Janeiro</b>	<b>\$ 1,988,415.00</b>
<b>TF3</b>	<b>Santiago/Sao Paulo</b>	<b>\$ 2,649,133.00</b>
<b>TF5</b>	<b>Lima/Sao Paulo/Rio de Janeiro</b>	<b>\$ 494,828.00</b>
<b>TF13</b>	<b>North South America/Europe</b>	<b>\$ 2,811,628.00</b>
<b>TF14</b>	<b>Mexico/Europe</b>	<b>\$ 3,347,273.00</b>
<b>TF16</b>	<b>Central America/Europe</b>	<b>\$11,211,868.00</b>
<b>TF17</b>	<b>South America/South Africa</b>	<b>\$ 704,652.00</b>
<b>TF18</b>	<b>Santiago/Easter Island/Papeete</b>	<b>\$ <u>56,853.00</u></b>
	<b>Total Phase III</b>	<b>\$26,413,218.00</b>

#### **4.5 Recommendation for Phase III**

4.5.1 As a result of the completion of Phase III, it is recommended that the flows analyzed during this phase be also included for consideration relating to the introduction of RNAV routes and RNP values.

4.5.2 It should be noted that in estimating the annual savings for each of the city pairs, it was assumed that the RNAV distance would be equal to the orthodromic distance, which is seldom the case since in the establishment of RNAV routes, considerations must be given to SIDs and STARs, mountain ranges, restricted areas and others. Therefore, the savings are somewhat less than those indicated, but still very significant.

#### **5. Other observations and recommendations**

5.1 In the analysis of the results of the survey, other important factors were highlighted and they are as follows:

##### **5.2 Congestion areas**

5.2.1 While most of the areas in the CAR/SAM regions have low to medium volume of traffic, the northern part of the Regions, especially for the following corridors, show very high levels of traffic:

- Mexico-Los Angeles;
- Mexico-Dallas/Houston;
- Cuba/Venezuela-Miami;
- South America-Europe (South Atlantic); and
- Buenos Aires-Sao Paulo-Rio de Janeiro.

5.2.2 To alleviate the congestion and allow more flights at optimum flight levels, a viability study on the use of Reduced Vertical Separation Minima (RVSM) should be made mainly for those areas.

### **5.3 Human Resources**

5.3.1 The transition to CNS/ATM systems will create new demands on human resources, especially during the transition period where both conventional and new technology systems will need to be operated in parallel. The survey reveals that there is already a severe shortage of trained personnel and that this condition continues to get more acute as the volume of traffic increases. Considering the lead time necessary to select and train people, actions should be immediately undertaken to meet present operational requirements and prepare for the CNS/ATM transition. (See **Appendix G**)

### **5.4 Phase IV**

5.4.1 Phase IV is referred to as the “Consolidation Phase”. Considering that while some immediate improvements could be achieved during the first three Phases through the establishment of RNAV routes and implementation of some of the CNS/ATM elements, the major transition to CNS/ATM will only be possible once the results of the analysis of the traffic flows are completed and their requirements consolidated. Considering that many of the nav aids are being used for multiple functions, their replacement cannot be considered until all functions are consolidated. For example, it would not be possible to consider the replacement of a VOR/DME if that same nav aid is also being used for TMA operation and/or as a nav aid for other crossing traffic flows. Phase IV is where the major benefits to States will be achieved through the non-replacement of conventional nav aids, the reduction in operating and maintenance cost and the reduction, if not elimination, of flight inspections. Throughout the project, estimates are provided on the potential future savings. As the project progresses and more information is made available, these results are refined and, at the final stage, used to perform the necessary costs benefits analysis and sensitivity analysis to ascertain the viability of the selected solutions. This phase is expected to be completed during 2002; furthermore, it should also be recalled that part of the tasks of Phase IV have now been relocated into Phases V and VI, which are in planning process.