RNAV-II
WP/08
23/04/01

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

**Second Meeting/workshop of Air Traffic Management (ATM) Authorities and Planners**
(Lima, Peru, 14 to 18 May 2001)

**Agenda Item 3: Analysis of pre-operational trials and demonstrations in new RNAV routes between Buenos Aires/Miami, Sao Paulo-Rio de Janeiro/New York and Sao Paulo-Rio de Janeiro/Los Angeles and evaluation of other paths.**

(Presented by the Secretariat)


**Summary**

This working paper contains some comments on the origin of pre-operational trials and demonstrations. It also proposes for consideration by the Meeting the implementation of three new flight paths linking up the cities of Buenos Aires/Miami, Sao Paulo/Los Angeles, and Sao Paulo-Rio de Janeiro/New York on which new pre-operational trials and demonstrations would be conducted.

**References**:

- Second Meeting of the GREPECAS CNS/ATM/IC Subgroup
- First Meeting/Workshop of Air Traffic Management (ATM) Authorities and Planners
- Reports of the First, Second and Third Meetings of the Coordinating Committee of UNDP/ICAO Project RLA 98/003
- Preliminary Reports of Project RLA 98/003


## 1. Background

1.1. According to the plans developed by the CAR/SAM Regional Planning and Implementation Group (GREPECAS) and endorsed by the CAR/SAM/3 RAN Meeting, pre-operational trials and demonstrations are under way for use of direct RNAV routes capable of being flown by aircraft with RNAV capabilities.

## 2. Analysis

2.1 The purpose of these pre-operational trials and demonstrations is to make it possible to identify problems during the implementation process, allow users to use avionics already installed in their aircraft and thereby obtain substantial flight time and fuel savings between selected pairs of cities, and finally to apply the longitudinal separation of 10 minutes and/or 80 NM RNAV between aircraft at the same level, with the support of the Mach number technique (MNT).

2.2 Use of these routes will not only benefit airlines economically due to reduced flight times, but will also give crews and controllers the necessary experience to control these types of routes in the future as RNAV routes proliferate.

2.3 On the other hand, as is well known, an ICAO project is underway to assist States in the Caribbean and South American (CAR/SAM) Regions in their transition to CNS/ATM systems. The first phase of this three-year technical cooperation project financed by the participating States through the United Nations Development Programme (RLA/98/003) has been completed with encouraging results.

2.4 The initial result (Phase 1) of this Project indicates that implementation of some CNS/ATM elements could yield immediate and significant economic and environmental benefits. In this sense, **Appendix B** to this working paper summarises the estimated savings to be obtained by implementing RNAV routes between the cities under consideration. Likewise, the current lack of coverage by CNS systems and the difficulty in maintaining reliable operations in certain parts of the regions has prevented the establishment of uniform separation standards and procedures. On the other hand, the existence of complicated coordination procedures for civil and military operations has resulted in the creation of less than optimum air routes.

2.5 As a result of the foregoing, the application of solutions in two stages has been suggested. First, the immediate introduction of some CNS/ATM-based solutions would improve operational safety and efficiency and result in significant operational savings for aircraft operators. Second, the gradual transition to CNS systems primarily based on the use of satellites well adapted to this type of operational environment would produce large savings for service providers.

**2.6** Although the CNS/ATM/IC Subgroup initially took on the coordination of the implementation of a trial and demonstration programme for the different components of the ATM system in the CAR/SAM Regions on a series of long-haul (RNAV) routes, the UNDP/ICAO Project RLA/98/003, through its Coordinating Committee, considered these pre-operational trials and demonstrations to be highly advantageous for the CAR/SAM Regions and felt that it would be very convenient to incorporate these activities into the Project.

### 2.7 General considerations regarding the routes

2.7.1 During the planning process, it was agreed that it should be possible to make adjustments in the routes for any of the following reasons:

a. Areas without an efficient communication coverage

b. Special use of airspace

c. Conditions in terminal areas

d. Aircraft limitations with respect to operations over mountainous areas and descent criteria

e. Emergency procedures

**Selection of routes for pre-operational trials and demonstrations**

2.8 Project RLA/98/003 considered that the activities carried out by the GREPECAS ATS Subgroup with regard to the identification of the RNAV routes required to improve air navigation in the CAR/SAM Regions and the priorities assigned by said Group to the RNAV routes in question should be taken into account when proceeding with the pre-operational trials and demonstrations.

2.9 These pre-operational trials and demonstrations are aimed at not only improving air navigation efficiency and hence procuring large economic benefits for users, but also at allowing most of the States to take part in this exercise. For that reason, selection of the new proposed flight paths took into account the involvement of the largest number possible of CAR/SAM States, in addition to purely operational aspects.

2.10 Accordingly, the following pairs of cities were selected for the conduction of pre-operational trials and demonstrations:

| | | |
|---|---|---|
| a. | Buenos Aires/Miami | RNAV route **UT 410** |
| b. | Sao Paulo /Los Angeles | RNAV route **UT 655** |
| c. | Sao Paulo / New York | RNAV route **UT 776** |
| d. | Rio de Janeiro/New York | RNAV route **UT419** |

## 3. Conclusion

3.1 The aeronautical community is extremely interested in continuing the implementation of RNAV trial and demonstration routes, which will make it possible not only to identify problems during the implementation process, but also to start implementation of the RNAV routes identified by GREPECAS and permit users early utilization of the avionics already installed in their aircraft and thereby to obtain significant savings in flight time and fuel between selected pairs of cities and in the associated operating costs.

3.2 It was also understood to be an appropriate mechanism for achieving uniform implementation at the CAR/SAM regional level of the longitudinal separation of 10 minutes and/or 80 NM RNAV between aircraft at the same cruising level, with the assurance of the Mach number technique (MNT).

3.3 Use of these routes would not only benefit airlines economically due to reduced flight times, but would also give crews and controllers the necessary experience to control these types of routes in the future as these RNAV routes proliferate.

3.4 In light of the foregoing, the meeting could examine the proposed RNAV pre-operational trial and demonstration listed in **Appendix A** to this working paper, the impact that implementation of the cited RNAV routes would have on the structure of the airspace under the responsibility of each administration, and any other aspect which could affect implementation of said routes.

## 4. Suggested action

4.1 The meeting is invited to take note of the information provided in this working paper and:

a. to review the flight paths of the proposed RNAV routes listed in **Appendix A** and the related chart;

b. analyse the impact that implementation of said routes could have on airspace structure;

c. review any other aspect which might affect implementation of said routes; and

d. approve the following Conclusion:

Conclusion X/X Agreement to conduct pre-operational trials and demonstrations on the Buenos Aires/Miami (UT 410), Sao Paulo/Los Angeles (UT 655), and Sao Paulo-Rio de Janeiro/New York (UT 776) and Rio de Janeiro/New York (UT419-UT776) RNAV routes

In order to gain experience in the implementation process, from conception to operational use, and to allow users to utilise the avionics already installed in their aircraft and thus obtain significant savings in flight time and fuel between selected pairs of cities, the participating States on the one hand and IATA, on behalf of the airlines on the other, agree to the following:

a) To conduct pre-operational trials and demonstrations on the **Buenos Aires/Miami, UT 410**, **Sao Paulo/Los Angeles, UT 655, Sao Paulo/New York, UT766 and Rio de Janeiro/New York, UT 419/UT776** RNAV routes, which are described in detail in **Appendices .....** to this part of the report;

b) To start pre-operational trials and demonstrations on**.....** 2001 and carry them out until **.....** 2002;

c) IATA commits itself to provide ICAO with a list of participating airlines by no later than**.....** 2001;

d) Airline users that are not IATA members, international general aviation, and State aircraft may take part in the trials and demonstrations described in a) above, provided that they meet the respective requirements; and

e) the procedures, minimum requirements for use of the routes in question, and aspects of ATC controller and crew training will be those that are set out under item …. of this report.

**Appendix A**

**Specific details of the Buenos Aires/Miami (UT 410), Sao Paulo/Los Angeles (UT 655), and Sao Paulo-Rio de Janeiro/ New York (UT 776) and Rio de Janeiro/New York (UT419-UT776) RNAV routes**

| **RNAV Route UT-410** BUENOS AIRES / MIAMI | | | |
|---|---|---|---|
| **FIRs or significant points** | **LATITUDE** | **LONGITUDE** | **CODE** |
| PARANA VOR/DME | S 31° 48’ 28” | W 060° 29’ 14” | PAR VOR/DME |
| EZEIZA/ CORDOBA | TBD | | ARUNO |
| CORDOBA/LA PAZ | S 22° 24’ 00” | W 064° 08’ 00” | ELAKA |
| LA PAZ / PORTO VELHO | S 10° 40’ 00” | W 067° 50’ 00” | ISARA |
| PORTO VELHO / BOGOTA | S 03° 33’ 00” | W 069° 46’ 00” | ARUXA |
| Existent Reporting point | S 02° 42’ 30” | W 070° 00’ 48” | PABON |
| BOGOTA / BARRANQUILLA | TBD | | IROTI |
| BARRANQUILLA / KINGSTON | N 15° 00’ 00” | W 075° 47’ 51” | EGAPO |
| KINGSTON / LA HABANA | N 19° 26’ 35” | W 077° 21’ 53” | PULKA |
| LA HABANA / MIAMI (Existent reporting point) | N 24° 00’ 00” | W 079° 04’ 11” | URSUS |

**FIRs involved:**
Ezeiza
Córdoba
La Paz
Porto Velho
Bogota
Barranquilla
Kingston
La Habana
Miami

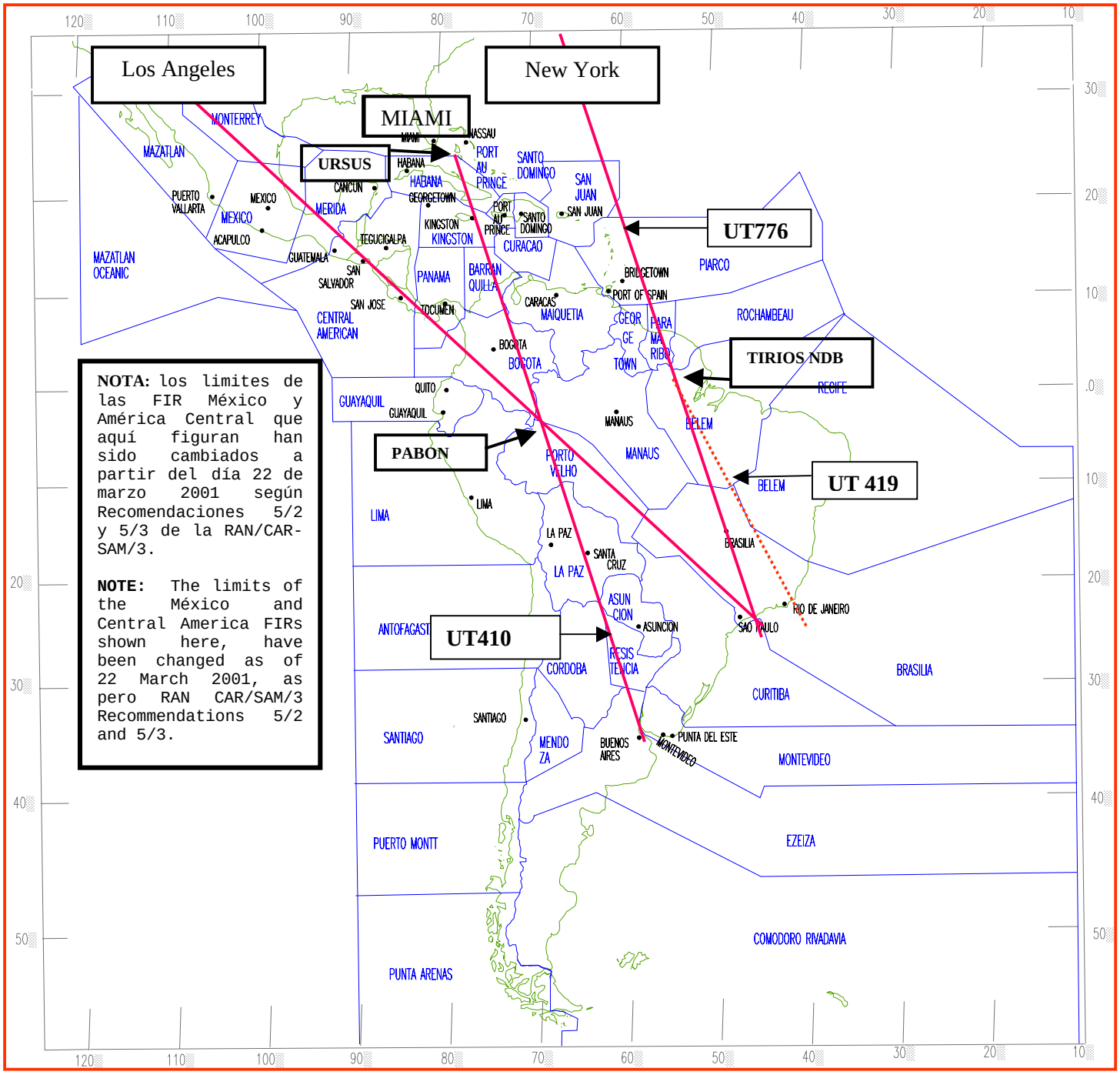
| **RNAV Route UT-655** SAO PAULO /LOS ANGELES | | | |
|---|---|---|---|
| **FIRs or siginificant points** | **LATITUDE** | **LONGITUDE** | **CODE** |
| CAMPINAS VOR/DME | S 23° 00’ 30” | W 047° 07’ 42” | CPN VOR/DME |
| BRASILIA / CURITIBA | TBD | TBD | ARUBU |
| CURITIBA / BRASILIA | TBD | TBD | EGIMO |
| BRASILIA / PORTO VELHO | TBD | TBD | ISENA |
| PORTO VELHO / BOGOTA | S 03° 00’ 24” | W 069° 42’ 30” | ASAPA |
| Existing reporting points | S 02° 42’ 30” | W 070° 00’ 48” | PABON |
| BOGOTA / PANAMA | N 05° 56’ 38” | W 079° 13’ 19” | ASEPI |
| PANAMA / América Central | N 09° 20’ 49” | W 082° 56’ 00” | EGODI |
| América Central / MÉRIDA | TBD | TBD | IROMA |
| MÉRIDA / MÉXICO | TBD | TBD | UGATA |
| MÉXICO / LOS ÁNGELES | N 32° 38’ 47” | W 115° 43’ 12” | ASUTA |
| Trajectory ASUTA / LOS ÁNGELES will be established during the Meeting | TBD | TBD | TBD |

**FIRs involved:**

Brasilia
Curitiba
Porto Velho
Bogota
Panama
Central America
Merida
México
Los Angeles

| **RNAV Route UT-776** SAO PAULO / NEW YORK y RIO DE JANEIRO/ NEW YORK **(UT419/UT776)** | | | |
|---|---|---|---|
| **FIRs or significant points** | **LATITUDE** | **LONGITUDE** | **CODE** |
| BRAGANCA VOR/DME (Sao Paulo) | S 22° 57.10' | W 046° 34.10' | BGC VOR/DME |
| PORTO VOR/DME (Río de Janeiro) | S 22º 42' 54'' | W 042º 51' 27'' | PCX VOR/DME |
| BRASILIA / BELEM (UT 776 -Sao Paulo-New York) | TBD | | ORETA |
| BRASILIA / BELEM (UT 419 - Río de Janeiro-ARUKI) | TBD | | ARUKI |
| BELEM / PARAMARIBO (Existent reporting point - NDB) | N 02° 13' 24.50" | W 055° 56' 45.80" | TIRIOS **(1)** |
| PARAMARIBO/GEORGETOWN | N 05° 15' 00" | W 057° 17' 00" | UGRIS |
| GEORGETOWN / PIARCO (Existent reporting point) | N 08° 55' 00" | W 058° 43' 00" | EGEMA |
| PIARCO / SAN JUAN | N 17° 53' 00" | W 062° 11' 00" | IREXA |
| SAN JUAN / NEW YORK | N 23° 30' 00" | W 064° 33' 00" | ORAKO |
| Trajectory Orako/New York will be defined during the meeting | TBD | | TBD |
| **(1)** Intersection RNAV Route SAO PAULO-RIO DE JANEIRO / NEW YORK | | | |

**FIRs involved:**
Brasilia
Belem
Paramaribo
Georgetown
Piarco
San Juan
New York


Los Angeles
New York
MIAMI
URSUS
UT776
TIRIOS NDB
PABON
UT 419
UT410
NOTA: los limites de las FIR México y América Central que aquí figuran han sido cambiados a partir del día 22 de marzo 2001 según Recomendaciones 5/2 y 5/3 de la RAN/CAR-SAM/3.
NOTE: The limits of the México and Central America FIRs shown here, have been changed as of 22 March 2001, as pero RAN CAR/SAM/3 Recommendations 5/2 and 5/3.
MONTERREY
MAZATLAN
PUERTO VALLARTA
MEXICO
ACAPULCO
MERIDA
CANCUN
HABANA
GEORGETOWN
KINGSTON
PORT AU PRINCE
SANTO DOMINGO
SAN JUAN
CURACAO
GUATEMALA
TEGUCIGALPA
SAN SALVADOR
SAN JOSE
PANAMA
BARRAN QUILLA
CARACAS
MAIQUETIA
BOGOTA
QUITO
GUAYAQUIL
LIMA
LA PAZ
SANTA CRUZ
ASUN CION
ASUNCION
ANTOFAGAST
CORDOBA
SANTIAGO
MENDO ZA
BUENOS AIRES
MONTEVIDEO
PUNTA DEL ESTE
PUERTO MONTT
PUNTA ARENAS
MANAUS
PORTO VELHO
BELEM
BRASILIA
RIO DE JANEIRO
SAO PAULO
CURITIBA
RESIS TENCIA
ROCHAMBEAU
PIARCO
BRIDGETOWN
PORT OF SPAIN
TOWN
RECIFE
EZEIZA
COMODORO RIVADAVIA

## Appendix B

### Annual savings connected with the introduction of RNAV routes as estimated by Project RLA/98/003

| Route | Dist. Conventional route | Dist. RNAV route | Difference | Time saved | Number of Aircraft | Total saved per year in U$S |
|---|---|---|---|---|---|---|
| **Sao Paulo/ New York** | **4168** | **4106** | **62** | **8 min.** | **98** | **1.712.826** |

Note 1: Total annual savings include aircraft operating costs and fuel savings.
Note 2: The number of aircraft represents the types of small, medium, and heavy aircraft that operated on the route in question during the period of evaluation.
Note 3: The period used in the example (two weeks) was from **19 July to 1 August 1999**.
Note 4: Rated speed used was 480 knots.

| Route | Dist. Conventional route | Dist. RNAV route | Difference | Time saved | Number of Aircraft | Total saved per year in U$S |
|---|---|---|---|---|---|---|
| **Sao Paulo/ Los Angeles** | **5484** | **5350** | **134** | **17 min.** | **60** | **2.937.134** |

Note 1: Total annual savings include aircraft operating costs and fuel savings.
Note 2: The number of aircraft represents the types of small, medium, and heavy aircraft that operated on the route in question during the period of evaluation.
Note 3: The period used in the example (two weeks) was from **19 June to 2 July 2000**.
Note 4: The rated speed used was 480 knots.

| Route | Dist. Conventional route | Dist. RNAV route | Difference | Time saved | Number of Aircraft | Total saved per year in U$S |
|---|---|---|---|---|---|---|
| **Río de Janeiro/ New York** | **4239** | **4174** | **65** | **8 min.** | **24** | **519.957** |

Note 1: Total annual savings include aircraft operating costs and fuel savings.
Note 2: The number of aircraft represents the types of small, medium, and heavy aircraft that operated on the route in question during the period of evaluation.
Note 3: The period used in the example (two weeks) was from **19 July to 1 August 1999**.
Note 4: The rated speed used was 480 knots.

**Operating cost per hour of flight used for estimating savings according to type of aircraft in U$S**

| | | |
|---|---|---|
| Small aircraft: | 2,100.00 | (B 737-MD80) |
| Medium aircraft: | 3,200.00 | (A 320- B 757 - B 767) |
| Heavy aircraft: | 6,600.00 | (MD11 - B 747) |