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

**Fourth Meeting/Workshop of Air Traffic Management Authorities and Planners (APATM/4)**

(Santa Cruz, Bolivia, 27-31 January 2003)

**Agenda Item 1: Review of the RVSM route implementation programme**

(presented by the Rapporteur of the RNAV/RNP Task Force)


**Summary**

This working paper contains proposals to continue the work of the RNAV/RNP Task Force, taking into account the RNAV routes already implemented and the need for the effective participation of CAR/SAM States and International Organizations involved in said process.


**References**

- Report of the Third Meeting/Workshop of Air Traffic Management Authorities and Planners (AP/ATM/3) (Lima, Peru, 20-24 May 2002).
- Report of the Tenth Meeting of the CAR/SAM Regional Planning and Implementation Group (GREPECAS/10) (Las Palmas, Canary Islands, Spain, 23-27 October 2001).
- Report of the Eleventh Meeting of the CAR/SAM Regional Planning and Implementation Group (GREPECAS/11), (Manaus, Brazil, 03-07 December 2002).
- Manual on Required Navigation Performance (Doc 9613-AN/937).

## 1. Introduction

1.1 The GREPECAS/10 meeting, in Conclusion 10/10 – RNAV route network for the CAR/SAM Regions--, approved a plan covering 13 RNAV routes proposed for incorporation into the CAR/SAM ANP ATS route network in a first stage.

1.2 Of the thirteen cited routes, five have already been approved by the ICAO Council and are in the process of implementation. Six additional RNAV routes have been implemented since the meetings of CAR/SAM ATM Authorities and Planners were established in 2000.

1.3 However, the implementation of the new RNAV route network in the CAR/SAM Regions can not be limited to these routes and the studies for the implementation of additional routes must start immediately. Said studies should take into account Decision 2/1 of the Second Meeting of the ATM Committee, which points to the need for more thorough analyses before proceeding with the implementation of the RNAV/RNP route network.

1.4 This analysis should consider mainly those routes that may be eliminated from the CAR/SAM Basic ANP because of their scant utilization, RNAV route links with TMA traffic flows, and the existence of prohibited, restricted and danger areas.

1.5 From the user's perspective, an analysis of the navigation capabilities of the fleet flying in airspace where RNAV routes are being planned is vital to ensure that aircraft lacking area navigation capabilities will continue operating in such airspaces.

1.6 The implementation of the new RNAV route network must include a discussion and analysis of RNP application in airspaces with favourable cost-benefit ratios. Cost-benefit studies should be based mainly on statistical data on the utilization of optimum flight levels, delays caused by non availability of such levels, the possibility of improving the airspace structure, and the work load of air traffic controllers.

1.7 The modality used for studying complex issues, such as RNAV/RNP, in small groups, such as the RNAV/RNP Task Force, has not given good results, bearing in mind that the active participation of the States and International Organizations involved is fundamental for obtaining the data required for proper planning of the new CAR/SAM RNAV route network and RNP application in selected airspaces.

## 2. RNAV route network

2.1 The Second Meeting of the ATM Committee noted that the implementation of the new CAR/SAM RNAV route network depended on a thorough analysis of all aspects involved and required the active participation of all the parties concerned. In this respect, it formulated Decision ATM/2/1:

**DECISION ATM/2/1 ANALYSIS FOR THE IMPLEMENTATION OF RNAV ROUTES BY THE RNAV/RNP TASK FORCE**

That the RNAV/RNP Task Force, in close coordination with the States, Territories and International Organizations involved,

a) analyze the impact that the proposed RNAV routes might have on:

   i) The ATS conventional routes and other RNAV routes;
   ii) The fleet of aircraft operating on the ATS conventional routes without RNAV equipment;
   iii) The prohibited, restricted and dangerous zones;
   iv) The TMAs, mainly those where the proposed RNAV route begins and ends; and
   v) The provision of Air Traffic Services affects on the proposed network.

b) Identify, among other aspects, those conventional routes that might be eliminated from the CAR/SAM ANP – Vol. I Basic ANP, due to:

i) Low use and/or
ii) Substitution due to the implementation of a new RNAV route.

2.2 It is obvious that the RNAV/RNP Task Force can not carry out the required analysis to proceed with the implementation of the RNAV routes without the effective participation of all the States and International Organizations involved, since the airspace in each FIR has its peculiarities, especially with respect to the level of utilization of each route of the domestic and regional route networks and the traffic flow in each TMA.

2.3 Therefore, in order to begin its work, the RNAV/RNP Task Force needs the information mentioned in Decision 2/1 of the ATM Committee, especially regarding the routes that can be eliminated from the CAR/SAM Basic ANP due to their scant utilization or replacement with an RNAV route, RNAV route links with TMA traffic flows, and the existence of prohibited, restricted and danger areas.

2.4 Initial studies on the RNAV route network can be based on the trajectories proposed by the Fifth Meeting of the RNAV/RNP Task Force, excluding the RNAV routes already implemented, as shown in **Appendix A**. The States and IATA should review this proposal and make suggestions to enable its updating based on CAR/SAM user needs.

2.5 Once the trajectory list has been updated, it will be possible to prepare a draft of new RNAV routes, which should be reviewed initially by CAR/SAM States and IATA with respect to the aspects mentioned in Decision 2/1 of the ATM Committee and based on the **Guidance for the Implementation of RNAV Routes**, presented by the secretary of the ATM Committee to the Second Meeting of the ATM Committee of the GREPECAS ATM/CNS Subgroup, in working paper 2, as shown in **Appendix B**.

2.6 Another key issue for the continued implementation of the CAR/SAM RNAV route network is the need to harmonise national RNAV route implementation plans with the regional RNAV route plan. In this sense, the GREPECAS/11 meeting "deemed it necessary for civil aviation administrations to take the necessary measures to develop an RNAV Route Implementation Programme, indicating the actual implementation requirements and establishing the relevant coordination to enable regional implementation in an integrated, harmonious and timely manner", and formulated the following conclusion:

**GREPECAS CONCLUSION 11/21 NATIONAL RNAV ROUTE IMPLEMENTATION PROGRAMME**

That the ICAO NACC and SAM Regional Offices encourage the CAR/SAM States/Territories and International Organizations to draft national RNAV Route Implementation Programmes compatible with the CAR/SAM RNAV implementation programme, based on the actual implementation requirements, analysing the impact of implementation on the airspace, the aircraft fleet, on the provision of air traffic services, and establishing the relevant coordination to enable the integrated, harmonious and timely implementation of more direct RNAV routes.

2.7 Thus, it is essential for States and International Organizations to develop a domestic RNAV route implementation programme that is consistent with the regional plan, so as to avoid an overlap of the domestic and regional route networks. The domestic plan must contemplate the need to modify the

existing traffic flows to enable, insofar as possible, the use of regional routes for domestic flights and the integration of TMA points of entry and exit for both route networks.

2.8 Furthermore, when developing their domestic RNAV route networks, the administrations should, and insofar as possible, draw from the **Guidance for the Implementation of RNAV Routes** contained in **Appendix B** to this working paper.

3. **Measures to be adopted for RNP implementation**

3.1 Regarding RNP, the Second Meeting of the ATM Committee noted that the ATM Evolution Tables establish that RNP 10 will be appropriate for use in the CAR/SAM Regions, and the work carried out for the implementation of RNP 10 pre-operational trials in RNAV routes UL 780 and UL 302 indicate that this RNP value seems an appropriate solution for the establishment of parallel routes in the CAR/SAM Regions. However, more stringent values should be considered for their future application in specific areas of both regions.

3.2 It is important to note that, in keeping with the Manual on Required Navigation Performance (Doc. 9613-AN/937), paragraph 3.3.5, RNP 10 was developed for remote and oceanic airspaces. Consequently, in principle, RNP 10 should not be applied in continental airspaces with high traffic density, mainly due to the required 50 NM separation.

3.3 In this respect, the CAR/SAM Regions can be divided into quite different airspaces, namely, continental airspaces with high traffic density, continental airspaces that can be considered as remote airspaces (over the Amazon jungle), and oceanic airspaces. This heterogeneity of the CAR/SAM Regions makes RNP implementation a rather complex task.

3.4 In order to define the RNP value and the airspace where it would be applied, appropriate statistical data needs to be collected, especially regarding the use of preferred levels, delays caused by non availability of preferred flight levels and the work load of air traffic controllers.

3.5 Decision 2/3 of the Second Meeting of the ATM Committee sets forth the other factors that should be borne in mind when analyzing RNP application:

**DECISION ATM/2/3 STUDY FOR RNP IMPLEMENTATION IN THE CAR/SAM REGIONS BY THE RNAV/RNP TASK FORCE**

That the RNAV/RNP Task Force of the ATM Committee of the GREPECAS:ATM/CNS Subgroup,

a) carry out an analysis on the aspects which might affect RNP implementation, such as:

i) The flexible use of airspace (prohibited, restricted and special use airspace) and civil/military coordination;
ii) Optimization of the current structure of the routes network;
iii) The lowest level usable in RNP airspace
iv) Surveillance and communication coverage in certain FIRs;
v) The current navigation capacity of the aircraft fleet;
vi) Mixed operations (RNP and non-RNP aircraft) in a same airspace;
vii) Status of implementation of the WGS 84 Geodesic System in the CAR/SAM Regions;
viii) Harmonization of the geographical coordinates at the FIRs boundaries;
ix) Integrity of the aeronautical data base for air navigation;
x) Link SIDs/STARs with en-route flight;
xi) Harmonized ATM procedures;
xii) Contingency Procedures.
xiii) Other points that the Task Force may deem appropriate.

b) study and propose an RNP implementation strategy that establishes the most appropriate delineation of RNP airspace, such as: implementation selecting fixed ATS routes, by area or by airspace blocks; and

c) study the need to update ATM evolution tables.

3.6 In view of the foregoing aspects, it is important for each State to analyse the need for RNP implementation in its airspace, bearing in mind the aforementioned factors and, especially, the statistical data on the utilisation of optimum flight levels, delays caused by non availability of optimum flight levels, the possibility of reducing the work load of air traffic controllers and improving the airspace structure; and to provide the necessary information to the RNAV/RNP Task Force, which, based on that information, will harmonise RNP implementation in the CAR/SAM Regions.

3.7 A critical factor for RNP implementation is the navigation capability of the fleet that flies in a given airspace. In this respect, the GREPECAS 11 Meeting identified the need to collect data on aircraft navigation capabilities through the following conclusion:

**GREPECAS CONCLUSION 11/22 COLLECTION OF DATA ON RNP-APPROVED AIRCRAFT**

That, in order to have updated information on RNP-capable aircraft operating in the CAR/SAM Regions:

a) the CAR/SAM Monitoring Agency (CAR/SAMMA) start collecting such data from civil aviation authorities of both Regions; and

b) IATA provides information on the RNP capability of its operators.

3.8 It should be noted that CARSAMMA will only be able to collect data on RNP-10-approved aircraft, which account for a small portion of aircraft flying in the CAR/SAM Regions, taking into account the fact that operators are only interested in obtaining RNP-10 certification for aircraft flying in RNP-10 airspace.

3.9 Consequently, data will be collected on aircraft flying only on the EUR/SAM corridor in the Pacific, and, in the near future, on routes UL780 and UL 302. However, based on the definition of the airspace where a specific RNP value will be applied, one of the functions of CARSAMMA is to examine the number of RNP-approved operators.

3.10 The task force may use the CARSAMMA database to know what operators and types of aircraft are flying in a given airspace and, thus, define the feasibility of RNP implementation.

3.11 For the planning phase, it is important to know the navigation capability of the fleet, irrespective of its formal approval. Thus, the role of IATA, as the main international user of CAR/SAM airspace, is vital for the obtention of such information. Nevertheless, State participation is also important for learning about the navigation capability of the other users of the CAR/SAM airspace.

## 4. Suggested action

4.1 The meeting is invited to adopt the following draft conclusions:

**Draft Conclusion AP/ATM/4/XX RNAV TRAJECTORY LIST UPDATE**

That, in order to obtain an updated list of trajectories to proceed with the work of the RNAV/RNP Task Force, the CAR/SAM States, COCESNA and IATA:

a) adopt the list of trajectories shown in Appendix “X” to this part of the report, as a work draft for the implementation of the CAR/SAM RNAV route network; and

b) submit proposals to update the list of trajectories to the ICAO SAM and NAM Offices no later than 30 April 2003.

**Draft Conclusion AP/ATM/4/XX DRAFT RNAV ROUTE NETWORK**

That the RNAV/RNP Task Force submit a work draft for the implementation of the RNAV route network to the AP/ATM/5 meeting, scheduled for 16-20 June 2003.

**Draft Conclusion AP/ATM/4/XX ADOPTION OF THE GUIDANCE FOR THE IMPLEMENTATION OF RNAV ROUTES**

That CAR/SAM States and International Organizations adopt the Guidance for the Implementation of RNAV routes, shown in Appendix “X” to this part of the report, for the development of the domestic RNAV route plan.

**Draft Conclusion AP/ATM/4/XX ANALYSIS OF AIRSPACES FOR RNP APPLICATION**

That CAR/SAM States and International Organizations analyze the airspace under their jurisdiction that require RNP and send their RNP application proposals to the ICAO SAM and NAM Offices no later than 30 April 2003. Proposals should be based on the aspects mentioned in Decision 2/3 of the Second Meeting of the ATM Committee as well as on the following factors:

a) rate of flights conducted on non-preferred levels;

b) delays caused by non availability of preferred flight levels; and

c) air traffic controller workload reduction.

**Draft Conclusion AP/ATM/4/XX STRATEGY FOR RNP APPLICATION IN THE CAR/SAM REGIONS**

That the RNAV/RNP Task Force submit to the AP/ATM/5 meeting a proposal for a CAR/SAM RNP application strategy.

**Draft Conclusion AP/ATM/4/XX FUTURE MEETINGS OF THE RNAV/RNP TASK FORCE**

That, considering that the RNAV/RNP concept needs to be planned and implemented using a work method that guarantees the participation of States and International Organizations, future meetings of the RNAV/RNP task force should be held concurrently with the Meetings of ATM Authorities and Planners, under the auspices of Project RLA/98/003.

# LIST OF PROPOSED RNAV TRAJECTORIES

| | | | | | |
|---|---|---|---|---|---|
| ANU | MIA | Antigua | Miami | 25 | ANU/MIA |
| AUA | NYC | Aruba | New York | 7 | BUE/SRZ/CCS/AUA/NYC |
| AUA | SJU | Aruba | San Juan | 27 | AUA/SJU |
| AUA | MIA | Aruba | Miami | 2 | SAO/AUA/MIA |
| ASU | BUE | Asuncion | Buenos Aires | 26 | ASU/BUE |
| BGI | MIA | Barbados | Miami | 24 | BGI/MIA |
| BGI | NYC | Barbados | New York | 1 | SAO/RIO/BGI/NYC |
| BAQ | MIA | Barranquilla | Miami | 8 | BOG/MIA |
| BZE | HOU | Belize | Houston | 14 | SJO/MGA/TGU/SAP/BZE/MID/HOU/DAL |
| BZE | MIA | Belize | Miami | 17 | GUA/BZE/MIA |
| BOG | CCS | Bogota | Caracas | 12 | UIO/BOG/CCS |
| BOG | MIA | Bogota | Miami | 8 | BUE/BOG/KIN/MBJ/MIA |
| BOG | PTY | Bogota | Panama | 33 | BOG/OTY/GUA/MEX |
| BOG | UIO | Bogota | Quito | 12 | UIO/BOG/CCS |
| BOG | SJO | Bogota | San Jose | 51 | BOG/SJO |
| BUE | MIA | Buenos Aires | Miami | 8 | BUE/BOG/KIN/MBJ/MIA |
| BUE | MVD | Buenos Aires | Montevideo | 6 | BUE/MVD/SAO/RIO |
| BUE | RIO | Buenos Aires | Rio de Janeiro | 6 | BUE/MVD/SAO/RIO |
| BUE | SRZ | Buenos Aires | Santa Cruz | 7 | BUE/SRZ/CCS/AUA/NYC |
| BUE | SCL | Buenos Aires | Santiago Chile | 9 | BUE/SCL |
| CUN | DAL | Cancun | Dallas | 15 | PTY/CUN/HOU/DAL |
| CUN | HAV | Cancun | Havana | 37 | CUN/HAV |
| CUN | HOU | Cancun | Houston | 15 | PTY/CUN/HOU/DAL |
| CUN | MIA | Cancun | Miami | 13 | CUN/MIA |
| CUN | NYC | Cancun | New York | 30 | CUN/NYC |
| CUN | SJO | Cancun | San Jose | 29 | BUE/SJO/CUN |
| CCS | MIA | Caracas | Miami | 57 | RIO/CCS/PAP/MIA |
| CCS | NYC | Caracas | New York | 7 | BUE/SRZ/CCS/AUA/NYC |
| CCS | SJO | Caracas | San Jose | 52 | CCS/CTG/SJO |
| CCS | SRZ | Caracas | Santa Cruz | 7 | BUE/SRZ/CCS/AUA/NYC |
| CCS | SCL | Caracas | Santiago Chile | 40 | SCL/CCS |
| CTG | CCS | Cartagena | Caracas | 52 | CCS/CTG/SJO |
| CTG | MIA | Cartagena | Miami | 8 | BUE/BOG/KIN/MBJ/MIA |
| SAL | DAL | El Salvador | Dallas | 46 | SAL/HOU/DAL |
| SAL | HOU | El Salvador | Houston | 46 | SAL/HOU/DAL |
| SAL | LAX | El Salvador | Los Angeles | 3 | SAO/RIO/SAL/LAX |
| SAL | MIA | El Salvador | Miami | 18 | SAL/SAP/MIA |
| GCM | MIA | Gran Cayman | Miami | 21 | SJO/GCM/MIA/NYC |
| GDL | DAL | Guadalajara | Dallas | 48 | GDL/HOU/DAL |
| GDL | HOU | Guadalajara | Houston | 48 | GDL/HOU/DAL |
| GDL | LAX | Guadalajara | Los Angeles | 43 | LIM/GDL/LAX |
| GUA | HOU | Guatemala | Houston | 41 | GUA/HOU |
| GUA | MEX | Guatemala | Mexico | 33 | BOG/OTY/GUA/MEX |
| GUA | MIA | Guatemala | Miami | 17 | GUA/BZE/MIA |
| GUA | SJO | Guatemala | San Jose | 34 | SJO/SAL/GUA/MEX |
| GYE | LIM | Guayaquil | Lima | 10 | SCL/LIM/GYE/UIO/PTY/MIA |
| GYE | MIA | Guayaquil | Miami | 10 | SCL/LIM/GYE/UIO/PTY/MIA |
| GYE | SJO | Guayaquil | San Jose | 53 | LIM/GYE/SJO |

| | | | | | |
|---|---|---|---|---|---|
| GYE | SCL | Guayaquil | Santiago Chile | 10 | SCL/LIM/GYE/UIO/PTY/MIA |
| HAV | CCS | Havana | Caracas | 54 | CCS/HAV |
| HAV | MEX | Havana | Mexico | 38 | HAV/MEX |
| HAV | PTY | Havana | Panama | 55 | PTY/HAV |
| HAV | SDQ | Havana | Santo Domingo | 56 | SDQ/HAV |
| KIN | MIA | Kingston | Miami | 8 | BUE/BOG/KIN/MBJ/MIA |
| LIM | LAX | Lima | Los Angeles | 43 | LIM/GDL/LAX |
| LIM | MIA | Lima | Miami | 10 | SCL/LIM/GYE/UIO/PTY/MIA |
| LIM | SRZ | Lima | Santa Cruz | 4 | SAO/SRZ/LIM |
| LIM | SCL | Lima | Santiago Chile | 10 | SCL/LIM/GYE/UIO/PTY/MIA |
| LIM | HOU | Lima | Houston | 42 | LIM/HOU |
| LIM | SAO | Lima | Sao Paulo | 4 | SAO/SRZ/LIM |
| MGA | HOU | Managua | Houston | 14 | SJO/MGA/TGU/SAP/BZE/MID/HOU/DAL |
| MGA | MIA | Managua | Miami | 20 | MGA/MIA |
| MID | HOU | Merida | Houston | 14 | SJO/MGA/TGU/SAP/BZE/MID/HOU/DAL |
| MEX | DAL | Mexico | Dallas | 44 | MEX/HOU/DAL |
| MEX | SAL | Mexico | El Salvador | 34 | SJO/SAL/GUA/MEX |
| MEX | HOU | Mexico | Houston | 44 | MEX/HOU/DAL |
| MEX | LAX | Mexico | Los Angeles | 45 | MEX/LAX |
| MEX | PTY | Mexico | Panama | 33 | BOG/OTY/GUA/MEX |
| MEX | SAP | Mexico | San Pedro Sula | 35 | MEX/SAP |
| MEX | SJO | Mexico | San Jose | 34 | SJO/SAL/GUA/MEX |
| MBJ | MIA | Montego Bay | Miami | 8 | BUE/BOG/KIN/MBJ/MIA |
| MBJ | NYC | Montego Bay | New York | 36 | KIN/MBJ/NYC |
| MVD | RIO | Montevideo | Rio de Janeiro | 6 | BUE/MVD/SAO/RIO |
| MVD | SAO | Montevideo | Sao Paulo | 6 | BUE/MVD/SAO/RIO |
| PTY | HOU | Panama | Houston | 15 | PTY/CUN/HOU/DAL |
| PTY | MIA | Panama | Miami | 10 | SCL/LIM/GYE/UIO/PTY/MIA |
| PAP | MIA | Port au Prince | Miami | 57 | RIO/CCS/PAP/MIA |
| UIO | MIA | Quito | Miami | 10 | SCL/LIM/GYE/UIO/PTY/MIA |
| RIO | LAX | Rio de Janeiro | Los Angeles | 3 | SAO/RIO/SAL/LAX |
| RIO | NYC | Rio de Janeiro | New York | 1 | SAO/RIO/BGI/NYC |
| SJO | MIA | San Jose | Miami | 21 | SJO/GCM/MIA/NYC |
| SJO | NYC | San Jose | New York | 21 | SJO/GCM/MIA/NYC |
| SAP | SJO | San Jose | San Pedro Sula | 14 | SJO/MGA/TGU/SAP/BZE/MID/HOU/DAL |
| SAP | HOU | San Pedro Sula | Houston | 14 | SJO/MGA/TGU/SAP/BZE/MID/HOU/DAL |
| SAP | MIA | San Pedro Sula | Miami | 18 | SAL/SAP/MIA |
| SAP | MSY | San Pedro Sula | New Orleans | 47 | SAP/MSY |
| SRZ | MIA | Santa Cruz | Miami | 7 | BUE/SRZ/CCS/AUA/NYC |
| SRZ | SAO | Santa Cruz | Sao Paulo | 4 | SAO/SRZ/LIM |
| SCL | LAX | Santiago Chile | Los Angeles | 11 | SCL/LAX |
| SCL | MIA | Santiago Chile | Miami | 10 | SCL/LIM/GYE/UIO/PTY/MIA |
| SCL | SAO | Santiago Chile | Sao Paulo | 5 | SAO/SCL |
| SDQ | MIA | Santo Domingo | Miami | 22 | POS/SDQ/MIA |
| SDQ | NYC | Santo Domingo | New York | 7 | BUE/SRZ/CCS/AUA/NYC |
| SAO | DAL | Sao Paulo | Dallas | 32 | SAO/DAL |
| SAO | LAX | Sao Paulo | Los Angeles | 3 | SAO/RIO/SAL/LAX |
| SAO | MIA | Sao Paulo | Miami | 2 | SAO/AUA/MIA |
| SAO | NYC | Sao Paulo | New York | 1 | SAO/RIO/BGI/NYC |
| TGU | HOU | Tegucigalpa | Houston | 14 | SJO/MGA/TGU/SAP/BZE/MID/HOU/DAL |
| TGU | MIA | Tegucigalpa | Miami | 19 | TGU/MIA |

# GUIDANCE FOR THE IMPLEMENTATION OF RNAV ROUTES

## 1. Introduction

1.1 RNAV operations allow flying in any region of the airspace without the need to fly over the ground base navigation facilities. RNAV techniques applied in several parts of the world have proved that they have advantages over other traditional forms of navigation and that they give certain benefits, among which are:

- establishment of more direct routes;
- reduction of flight distances;
- establishment of deviation routes for aircraft flying over high traffic density areas;
- establishment of double or parallel routes to fit a larger amount of en-route traffic; and
- reduction of ground base navigation facilities.
- a better design or the airspace and the routes network.

1.3 The planning and implementation of RNAV routes demands an extensive analysis of all related issues that could affect such a process. The general guidelines for the analysis needed for this process are hereby presented.

## 2. Issues to consider during the implementation process

2.1 During the implementation process, the following issues must be taken into account:

a) Start/end points of the proposed RNAV routes;
b) The existing traffic flows and trajectories in the TMAs where the airports are located from the start/end points of the RNAV route;
c) The incorporation of traffic coming from intermediate cities;
d) The conventional ATS routes that are near the proposed RNAV routes;
e) The fleet that is not RNAV equipped;
f) The forbidden and restricted airspaces, which affect the RNAV route;
g) The adjacent FIRs airspaces, mainly CTRs and TMAs, that could affect or be affected by the RNAV routes;
h) The mountainous areas located near airports and along the RNAV route.

### *Start/end points of the RNAV routes*

2.2 One of the dilemmas for the implementation of RNAV routes that will join city pairs is to determine which reference to use in order to define the end points. Most airports are located in the terminal control areas that have already established the trajectories to order the traffic flows, IFR and VFR, National and International.

2.3 The selection of these points, either existent or new, shall determine definitively the real trajectory of the route, and therefore, the FIRs, ATS conventional routes and RNAV routes, and prohibited and restricted airspaces, etc., involved in the same.

2.4 The analysis for the selection of these points will have to contemplate all factors involved in order to avoid further modifications to the proposed trajectory and consequently to repeat the whole process, which would delay the implementation.

***Traffic flows and trajectories in the TMAs***

2.5 Traffic conditions at the TMA of airports could determine that traffic that flies over the proposed RNAV routes comes in through a different trajectory in order to maintain the great circle or to not interfere with the established trajectories. The complexity of the TMA, the importance of the traffic flows and/or the ATC workload have to be considered and incorporated into the traffic flows.

2.6 During the RNAV routes implementation process that is being carried out in the CAR/SAM Regions, some FIRs, specially the FIRs whose airports are located in the ends of the routes, have the tendency to establish a sole entrance or exit point to/from the FIR for all the routes proceeding from a same sector. In some cases, this point is located at a distance of hundreds of nautical miles from the exit/destiny aerodrome.

2.7 This happens due to the existence of forbidden and restricted airspaces as well as the preference to incorporate new RNAV routes to the existing arrival and exit trajectories. If the tendency is maintained without alterations, the flight distance may be significantly increased and it would impede the implementation of the parallel routes that will allow the optimum use of the airspace, alleviate the traffic congestion or make possible for the aircraft to fly at optimum flight levels.

2.8 Furthermore, the traffic from/to the TMAs at intermediate airports may be incorporated to the RNAV routes through SIDs/STARs and/or through RNAV auxiliary routes that allow maintaining the proposed RNAV routes in the great circle. The need to have RNAV routes arriving to intermediate cities is to be thoroughly analysed in order to avoid the separation of the great circle trajectory routes and to avoid the consequences mentioned in the last paragraph.

2.9 In this regard, it is necessary to use all necessary efforts and to establish the pertinent coordination to implement more direct RNAV routes, which will benefit air operations and the economy of air transport.

***Conventional ATS Routes***

2.10 It is necessary to have an analysis of the existing conventional ATS routes that coincide or are near the proposed RNAV routes. Considering that there will be numerous aircraft that will not have the area navigation equipment, there is the option to redirect to the conventional ATS routes and to move them far from the proposed RNAV routes. This will require the redesign of the airspace or they could be kept as they are and then establish maximum flight levels for these routes and minimum flight levels from RNAV routes.

2.11 During the transition stage, it seems most convenient to choose the second option, which is to segregate the use of the airspace, and for this end, there should be an extensive analysis to determine the real needs and the establishment of minimum operation requirements as well as specific ATS procedures for each block of airspace that allows the application and unequivocal compliance on behalf of the ATC and the users.

2.12 On the other hand, the analysis of traffic density in a particular traffic flow could make an RNAV route insufficient to meet the demands, considering that there are existing areas and route segments in which the aircraft are not operating at their optimum flight levels and it might be necessary to analyse establishing parallel RNAV routes to solve this situation.

***Restricted and forbidden zones***

2.13 Conceptually, the Airspace Management (ASM) assumes that the airspace should be dynamically shared by civil and military users. In an integrated ATM system, the airspace management is not limited to the tactical aspects of sharing airspace; it is also directed to bring strategic planning capabilities by taking into account the necessary harmonization that should exist when an airspace is shared.

2.14 In this regard, special attention should be given to the geographic location of forbidden and restricted airspaces, including the lateral and vertical boundaries and their impact on the implementation of more direct RNAV routes for the use of civil aviation.

2.15 The existence of restricted and forbidden zones affects the proposed trajectories of RNAV routes and will significantly increase the distances to be flown. Therefore, in order to accomplish the implementation of more direct RNAV routes, the corresponding authorities are required to take the necessary measures in order to have a harmonized civil/military coordination.

***Mountainous Areas***

2.16 The existence of mountainous areas along the boundaries of an airport may force a proposed RNAV route to be redirected in order to allow the SIDs/STARs design to be compatible with the aircraft performance during the corresponding ascent and descent.

2.17 The presence of mountainous areas along a route may affect the aircraft operations during the en-route phase and consequently may cause a redirection of the proposed RNAV route in order to comply with Annex 6 requirements, as far as oxygen provision in certain altitude and pressure conditions is concerned.

- END -