



INTERNATIONAL CIVIL AVIATION ORGANIZATION

South American Regional Office

REPORT

**Eleventh Meeting/Workshop of ATM authorities and planners in the
CAR/SAM Regions**

(AP/ATM/11)

(Lima, Peru, 28 to 30 September 2005)

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HISTORY OF THE MEETING

ii-1 PLACE AND DURATION OF THE MEETING

The Eleventh Meeting/Workshop of Air Traffic Management (ATM) Authorities and Planners of the CAR/SAM Regions was held in Lima, Peru, from 28 to 30 September 2005.

ii-2 OPENING CEREMONY AND OTHER MATTERS

Mr. Carlos Stehli, Regional Deputy Director (ai) of the ICAO Lima Office, welcomed the participants, expressed his gratitude to the Peruvian authorities for their attendance and continuous support to the events carried out in Peru, and gave a brief explanation of the issues to be reviewed during the meeting.

Mr. Stehli congratulated States/Territories and International Organizations and operators for the effort carried out for RVSM implementation which took place on 20 January 2005, highlighting the coordinations made and the team work which enabled a successful implementation. He also encouraged States of the CAR/SAM Regions to continue working with the same spirit of collaboration and regional cooperation, which will undoubtedly facilitate to face the new challenges for ATM global implementation and the corresponding CNS support.

Likewise, Mr. Roberto Rodríguez Galloso, Director General of Civil Aviation (ai), greeted the participants, highlighted the importance of the issues to be dealt with and encouraged all the parties involved to complete the pending tasks, inaugurating the meeting. Doctor Carlos Albuquerque Falen, President of CORPAC's Board, was also present at the opening session.

ii-3 SCHEDULE, ORGANIZATION, WORKING METHODS, OFFICERS AND SECRETARIAT

The Meeting agreed to hold its sessions from 0900 to 1600 hours, with appropriate breaks. The work was done with the Meeting as a Single Committee, Working Groups and Ad-hoc Groups.

Mr. Julio Pereira, delegate from Brazil, was elected as Chairman of the Meeting.

Mr. Jorge Fernández Demarco, ATM/SAR Regional Office, Lima, acted as Secretary, being assisted by the Working Groups Rapporteurs, Mr. Julio Cesar Pereira, (ATM/WG), Mr. Saulo José Da Silva (SAM/WG), and Mr. Andrés Prado (OPS/AIR/WG). The Secretariat was also composed by Mr. Víctor Hernández, RO/ATM from the ICAO NACC Regional Office.

The opportunity was taken to analyse issues related with the ATM Committee Scrutiny Working Group. This working group carried out its activities in parallel to the AP/ATM/11 Meeting.

ii-4 WORKING LANGUAGES

The working languages of the Meeting and its relevant documentation were English and Spanish.

ii-5 **AGENDA**

The following agenda was adopted:

- Agenda Item 1: Review of the RNAV/RNP Task Force and analysis of the actions adopted by the Task Force
- Agenda Item 2: RNAV/RNP issues related with the ATC Operations Working Group (ATC/WG)
- Agenda Item 3: RNAV/RNP issues related with the Aircraft Operation and Airworthiness Working Group (OPS/AIR/WG)
- Agenda Item 4: RNAV/RNP issues related with the Safety and Airspace Monitoring Working Group (SAM/WG)
- Agenda Item 5: Other matters

ii-6 **ATTENDANCE**

The meeting was attended by 5 States of the CAR Region and 10 States of the SAM Region, as well as by 5 International Organizations: AITAL, ARINC, COCESNA, IATA and IFALPA, totalling 69 participants. The list of participants is shown in pages iii-1 to iii-11.

ii-7 **LIST OF WORKING PAPERS AND INFORMATION PAPERS**

N°	Subject	Title	Prepared by
WP/01	-	Agenda, Schedule and Working Methods	Secretariat
WP/02	1	RNAV/RNPTF Terms of reference and work programme	Secretariat
WP/03	1	RNAV/RNP Implementation strategy and action plan for its implementation	Secretariat
WP/04	1	RNAV/RNP Questionnaire	Secretariat
WP/05	4	Agenda for GTE/2 Meeting	Secretariat
WP/06	3	RNAV/RNP issues related with the Aircraft Operation and Airworthiness Working Group (OPS/AIR/WG)	M. Ureña
WP/07	4	RNAV/RNP Issues related to the Safety and Airspace Monitoring Working Group (SAM/WG) - Infrastructure required to Implementation of the RNAV/RNP concepts in the CAR/SAM Regions	CARSAMMA
WP/08	6	Brazilian ATM Contingency planning	Brazil
WP/09	6	Review of the RNAV Phase II b implementation programme	Brazil

N°	Subject	Title	Prepared by
WP/10	1	Review of the RNAV/RNP Task Force and analysis of the actions adopted by the Task Force CAR/SAM Performance Based Navigation Road Map	RNAV/RNP Rapporteur
WP/11	2	SID/STAR Instrument Approach Procedures implementation - RNAV/RNP in the CAR/SAM Regions	Peru
WP/12	2	Development of a comprehensive profile of operators and aircraft types expected to use CAR/SAM airspace where the RNAV RNP Concepts could be applied	CARSAMMA
WP/13	3	Análisis del cumplimiento de los requerimientos de instrucción para realizar operaciones RNAV/RNP	CARSAMMA
WP/14	4	Examination of Large Height Deviation Reports Received by the Caribbean and South American Monitoring Agency (CARSAMMA) in Connection with the safe use of the Reduced Vertical Separation Minimum (RVSM) in the CAR/SAM Regions	CARSAMMA
IP/01	--	General Information of the Meeting	Secretariat
IP/02	--	List of working papers and information papers	Secretariat

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Decision AP/ATM/11/2	CAR/SAM Performance Based Navigation Road Map	2-4
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Conclusion AP/ATM/11/5	NAVAIDS Performance	4-2
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Conclusion AP/ATM/11/7	Harmonization of the ATS contingency plans of Argentina, Bolivia, Brazil and Paraguay	5-1
Conclusion AP/ATM/11/8	Implementation, extension, realignment, partial/total elimination and change of direction of RNAV and conventional routes	5-2

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Grupo de Escrutinio / S/WG

Agenda Item 1: Review of the RNAV/RNP Task Force and analysis of the actions adopted by the Task Force

1.1 The Meeting recalled that during the Fourth Meeting of the GREPECAS ATM/CNS Subgroup, ATM Committee, the RNAV/RNP concepts implementation strategy was analysed, as well as the terms of reference and work programme, as shown below:

Terms of Reference of RNAV/RNP/TF

1.2 Develop strategic guidelines for the RNAV/RNP implementation processes in the CAR/SAM Regions for en-route, terminal area and approach flight phases.

Work Programme of RNAV/RNP/TF

1. Develop a navigation roadmap based on the aircraft performance envisaging en-route and terminal area and approach operations in the short, mid and long term;
2. Develop the RNAV/RNP operational concept on which implementation will be based;
3. Harmonize the implementation plans among the different regions or sub-regions;
4. Inform the ATM Committee.

Work Programme of ATM, OPS/AIR and SAM WGs

1.3 The meeting recalled that, for implementation and planning purposes, adopted the same working methodology used by the RVSM Task Force was deemed convenient, in order to assign the Air Traffic Management (ATM), Aircraft Operation and Airworthiness (OPS/AIR), and Safety and Airspace Monitoring (SAM) issues to specific Working Groups ATM/WG, OPS/AIR/WG, and SAM/WG.

1.4 Taking into account the above, the meeting decided that ATM, OPS/AIR and SAM Working Groups develop a work programme, as shown in **Appendices A, B and C** to this part of the Report.

1.5 Working papers presented were reviewed and assigned to the different Working Groups. Also, the meeting considered that the presentations made during the Third CAR/SAM RNAV/RNP Seminar (Lima, Peru, 26 and 27 September 2005) and the NAM/CAR Region RNAV/RNP Seminar held in Mexico City (August 2005) were also taken as reference material for the execution of tasks assigned to each one of the Working Groups.

Scrutiny Working Group (S/WG)

1.6 The Scrutiny WG in charge of reviewing LHD reports for the CAR/SAM Regions met in parallel to the RNAV/RNP Meeting, and issued its report, jointly with the SAM Working Group.

Modification of the name for the RNAV/RNP Task Force

1.7 In order to align with the new concepts, the meeting analysed the convenience to modify the name of the RNAV/RNP Task Force to Performance Based Navigation Task Force (PBN/TF). This will enable the aeronautical community to understand changes related with RNAV and RNP navigation elements. In this connection, the meeting agreed on the following:

Decision AP/ATM/11/1 -**Modification of the RNAV/RNP Task Force**

That the Secretariat present GREPECAS a proposal for modification to the name of the RNAV/RNP Task Force to Performance Based Navigation Task Force (PBN/TF).

APPENDIX A**WORK PROGRAMME OF THE AIR TRAFFIC MANAGEMENT WORKING GROUP
(ATM/WG)**

The ATM/WG is responsible to deal with issues related with air traffic services in RNAV/RNP airspace, including the following:

- a) Contribute with the RNAV/RNP Roadmap for the CAR/SAM Regions in the ATM field.
- b) Develop the CAR/SAM RNAV/RNP Operational Concept.
- c) Identify the airspace in which concepts will be implemented.
- d) Recommend material and training methods for ATC personnel.
- e) Harmonize the necessary changes to the regional documentation.
- f) Provide the appropriate material for the RNAV/RNP internet website.
- g) Comply with other tasks as required by the RNAV/RNP Task Force Plenary.
- h) Develop the principles in which PBN implementation will be based.
- i) Adopt the new PBN, RNAV and RNP concept.
- j) Identify the benefits of PBN implementation.
- k) Analyse Traffic forecasts in the CAR/SAM Regions.
- l) Define short, mid and long terms.
- m) Establish ATM requirements.
- n) Establish guidelines for data collection for airspace planning and safety assessment.
- o) Analyse the need for application of in-flight (airborne) contingency procedures.
- p) Analyse the need for additional aeronautical phraseology for RNAV/RNP operations.
- q) Identify the need for utilisation of simulation tools in speed time.

APPENDIX B**WORK PROGRAMME OF THE AIRCRAFT OPERATIONS AND AIRWORTHINESS
WORKING GROUP (OPS/AIR/WG)**

The OPS/AIR/WG is responsible for addressing pilot operations, airworthiness, and aircraft approval issues, and:

- a) To contribute with the roadmap in the OPS/AIR environment.
- b) To harmonize policy on operations and airworthiness issues related to RNAV and RNP.
- c) To develop and harmonize guidance related to the implementation of RNAV/RNP, including Minimum RNAV/RNP Aircraft System Performance Specifications (MASPS); and considering the infrastructure of communications, navigation and existing and planned surveillance for CAR/SAM Regions.
- d) To develop a procedure for verification of competence of aircraft flight crews which have reached its navigation capacity based on service performance and which do not count with simulators with such capacity.
- e) To track the progress made by States on the tasks listed and report it to the PBN/TF;
- f) To send the appropriate material to the PBN/TF website administrator;
- g) To accomplish other tasks as directed by the full PBN Task Force.

APPENDIX C

WORK PROGRAMME OF THE SAFETY AND AIRSPACE MONITORING WORKING GROUP (SAM/WG)

The SAM/WG is responsible for mathematical and statistical analysis to assist with the maintenance and on going monitoring of safety through the assessment of collision risk for the CAR/SAM Regions en-route operations and other tasks as agreed with RNAV/RNP Task Force. The main tasks of the SAM/WG are:

- a) To contribute with the RNAV and RNP Roadmap for the CAR/SAM Regions in the safety assessment and airspace area.
- b) To develop a program of data collection to support its activities;
- c) To develop a monitoring program to ensure that the quantity and quality of the data collected allow an assessment of the collision risk;
- d) To review existing mathematical and statistical techniques to assure their appropriateness for the CAR/SAM regions;
- e) To ensure the transferability of aircraft data collected in other airspace regions;
- f) To support the assessment of the safety of the operations using the RNAV and/or RNP concepts during the Verification and Operational Phases by the production of collision risk assessments based on data collected to determine whether the TLS is being met;
- g) To devise suitable methodologies for incorporating the effects of projected traffic increases and system changes on occupancy and collision risk in the future environment;
- h) To identify those elements which are critical in the assessment of collision risk and suggest areas where improvements might be effective in reducing risk;
- i) To establish a policy for investigating those errors that may jeopardize satisfaction of the Target Level of Safety (TLS);
- j) To coordinate periodically data collections in order to ensure that the parameter values used in the collision risk models remain current;
- k) To track the progress of the States under the task list and to report States' progress to RNAV/RNP TF;
- l) To accomplish other tasks as directed by the RNAV/RNP Task Force;
- m) To provide material for the RNAV/RNP website administrator;

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- n) To verify the lateral and longitudinal separation minima applicable in the CAR/SAM Regions using the collision risk models, taking into account the communications, navigation and surveillance infrastructure;
 - o) Coordinate with CARSAMMA the establishment of an approved aircraft database to fly within RNAV and/or RNP designated airspace.

Agenda Item 2: RNAV/RNP issues related with the ATM Operations Working Group (ATM/WG)

Performance-based navigation (PBN) implementation strategy

2.1 The meeting adopted the strategy described hereunder, to avoid the need for multiple operational approvals for flights in the CAR/SAM Regions.

En-route operations

2.2 It was considered that the strategy to follow for en route operations will be the performance-based navigation (PBN) implementation by routing areas in CAR and SAM scenarios, depending on the operational needs and infrastructure features of each Region. This strategy will allow the establishment of the RNAV and/or RNP values for the various areas which will be harmonized by the RNAV/RNP Task Force.

TMA operations

2.3 For TMA operations, the States/Territories and International Organizations will develop National Implementation Plans based on PBN Operational Concept; once applicable separation criteria among aircraft are issued by ICAO Headquarters.

Action Plan for PBN Implementation in the CAR/SAM Regions

2.4 The meeting recalled that the ATM Committee examined this subject and agreed that PBN Implementation Groups should use action plans for the development of both en route and TMA operations tasks: Also, States should use action plans for the development of tasks for TMA operations.

2.5 The ATM, OPS/AIR and SAM Working Groups examined the action plan models approved by the ATM Committee, agreeing to carry out some modifications. The amended action plan models for en route and TMA operations are shown in **Appendices A** and **B** to this part of the report, and will serve as basic guidelines for implementation.

Questionnaire on Performance Based Navigation

2.6 Keeping in mind the need to obtain information to endorse PBN implementation in the CAR/SAM Regions, the Fourth Meeting of the GREPECAS ATM/CNS Subgroup ATM Committee analysed and adopted PBN questionnaire where States are consulted on RNAV and RNP matters.

2.7 In addition, the meeting recalled that the ATM Committee adopted Draft Conclusion ATM/4/2 – PBN Questionnaire requesting ICAO to collect from States/Territories and International Organizations the information corresponding to the PBN questionnaire, and that the same be presented by 31 January 2006.

2.8 The meeting analyzed this questionnaire and decided to introduce some changes to it. The modified questionnaire in **Appendix C** to this part of the report.

Performance Based Navigation Road Map in the CAR/SAM Regions

2.9 The meeting considered that the development of a road map is a key issue to harmonize the implementation of PBN in the CAR/SAM Regions. In this regard, taking into consideration the methodology applied in other regions to elaborate a road map, the following steps were agreed upon to be taken:

- a) Establish Partnerships & Collaboration
- b) Define Safety, Capacity and Efficiency Goals
- c) Determine Implementation Time Horizons
- d) Define Operational Domains for Implementation
- e) Understand Air Traffic Demand and Growth
- f) Define Operational Concepts for the near, mid and far terms
- g) Develop an Equipage Inventory on board aircraft, and CNS infrastructure when necessary
- h) Develop enabling criteria, standards and guidance material
- i) Conduct Post-Implementation Analysis
- j) Develop Harmonized Strategies

2.10 Most of the parties involved in PBN implementation attend the AP/ATM Meetings. IATA, IFALPA, Air Navigation Service Providers, Regulators and Regional Authorities, military authorities, etc. However, the information regarding some other important parties (Airports, General and Business Aviation, Local Communities) in the process depends on the information that is provided by AP/ATM members. Taking into consideration that the RLA/98/003 Project is about to end, the RNAV/RNP Task Force should find another way to obtain this partnership for the development of the CAR/SAM Performance Based Navigation Road Map.

Definition of Safety, Capacity and Efficiency Goals

2.11 The RNAV/RNP Task Force should find a way to establish goals and metrics in order to guide the implementation of Performance Based Navigation in the CAR/SAM Regions. Several examples of parameter that must be taken into consideration could be given:

- a) Safety – TLS 5 X 10⁻⁹ accidents per flight hour per aircraft
- b) Controller Workload – The implementation of PBN is expected to reduce the Controller Workload. However, depending on how this implementation will be done (mix of aircraft of different capabilities, for example), the Controller Workload could be increased.
- c) Economy, Efficiency and delays – These parameter must be included in the Cost-Benefit Analysis.
- d) Access and Flexibility – the implementation must take into consideration the non equipped users.

Determination of Implementation Time Chart

2.12 It will be necessary to the RNAV/RNP Task Force to establish near, mid and long term strategy to implement Performance Based Navigation, in accordance with safety, capacity and efficiency benefits to be obtained in each phase.

Definition of Operational Domains for Implementation

2.13 Normally the operational domains for implementation of Performance Based Navigation are En route, TMA and Approach. The Airport Operations must be taken into consideration, in order to avoid delays due to the ground infrastructure.

Understanding of Air Traffic Demand and Growth

2.14 The Air Traffic Demand and Growth is a key element of the Performance Based Navigation Road Map, taking into consideration that one of the main objectives of PBN operations is to attend the Air Traffic Demand and its growth. Along these lines, the collection of traffic data carried out from 1 to 15 July 2005, in accordance with Conclusion AP/ATM/10/8, started the process to obtain the actual demand in the higher airspace. The meeting should discuss if it will be necessary to expand the data collection in order to obtain traffic data from the lower airspace and the TMA. Regarding the growth of traffic, the meeting should analyze the best mean to obtain this data, probably using the GREPECAS Traffic Forecasting and Economic Planning.

2.15 During the planning and implementation process of Performance Based Navigation, Fast Time Simulation should be used to define the best airspace structure. This kind of simulation depends on the quality of data, mainly the air traffic demand and forecast.

Definition of operational concepts for the near, mid and long terms

2.16 In accordance with the RNAV/RNP Task Force Working Programme, it will be necessary to develop an Operational Concept, in order to harmonize the implementation process in the CAR/SAM Regions.

Development of a fleet and CNS infrastructure equipment inventory

2.17 The collection of traffic data carried out from 1 to 15 July 2005, in accordance with Conclusion AP/ATM/10/8, was the first step to understand the traffic demand. The second step will be its collection through a new questionnaire to States, Territories and International Organizations consulting on fleet equipment operating in the Region, as well as available CNS infrastructure.

Development of criteria, standards and guidance material

2.18 One of the main ICAO objectives is to harmonize the application of PBN all over the world. Along these lines, CAR/SAM Regions will apply standards and criteria already developed. One possible example is to use RNAV-5 or RNAV-2 for en route operations in some airspace in the CAR/SAM Regions.

Conduction of post-implementation analysis

2.19 The Post-Implementation Analysis Strategy should be included in the Performance Based Navigation Road Map, mainly regarding safety and efficiency, taking into consideration the need of a close follow-up of the PBN operations, after a new implementation.

Development of harmonized strategies

2.20 Taking into consideration that is expected a number of Performance Based Navigation Implementation Task force in the CAR/SAM Regions, it will be essential to include in the Performance Based Navigation Road Map a strategy to guarantee the Regional and Inter-Regional PBN harmonization.

Content of CAR/SAM Performance Based Navigation Road Map

2.21 The meeting analyzed the basic contents of the CAR/SAM Performance Based Navigation Road Map, which includes the items in **Appendix D** to this part of the Report. In this regard, the meeting also adopted some coordination dates for the elaboration of this document, as well as assigned the experts responsible for the task. In light of the above, the following was approved:

Decision AP/ATM/11/2 - CAR/SAM Performance Based Navigation Road Map

That the experts shown in Appendix D, take pertinent measures to develop the tasks assigned, with the aim of finalizing and providing the Secretariat, before 28 February 2006, with the content of the CAR/SAM Performance Based Navigation Road Map.

Training of Experts in the ATM, OPS/AIR and SAM fields

2.22 Taking into account that the Performance Based Navigation implementation in the CAR/SAM Regions will demand a wide restructuring of airspace, even more complex than RVSM implementation, it is important that experts in ATM, OPS/AIR and SAM fields be trained in accordance with this implementation.

2.23 The ICAO initiative of carrying out the safety assessment course through a Special Implementation Project could be taken as an example for developing similar courses in the ATC field, mainly for Airspace Planners and OPS/AIR.

SID/STAR and Instrument Approach Procedures RNAV/RNP Implementation in the CAR/SAM Regions

2.24 The meeting recalled that during the CAR/SAM RNAV routes implementation process, which is being successfully developed, it has been identified the need of the RNAV SID/STAR implementation which will allow the connection between start/end airports, as well as the intermediate airports, corresponding to the trajectories of such RNAV routes.

2.25 Nevertheless, in accordance with the available information, there are few Civil Aviation Administrations of the CAR/SAM Regions which have implemented RNAV SID/STAR in their corresponding Terminal Control Areas that allow the link with RNAV routes already implemented.

2.26 The meeting recalled that the PANS/OPS – Aircraft Operations - Doc. 8168, Vol. II, development of instrument and visual flight procedures, of ICAO, contains the current criteria of obstacle clearance in order to design RNAV and RNP Instrument Approach and SID/STAR procedures.

2.27 Keeping in mind the above, and with the aim of accomplishing with the objective to establish an integral and harmonious RNAV and RNP implementation during all the flight phases, it was thought convenient that the CAR/SAM Regions Administrations consider including the RNAV/RNP SID/STAR and Instrument Approach Procedures Implementation in their National Plans, in accordance with their particular needs and objectives.

Collection of information on air traffic movements in the CAR/SAM Regions

2.28 The meeting recalled that in the Tenth Meeting/Workshop of Air Traffic Management (ATM) Authorities and Planners, it was decided that traffic movement data should be collected for the CAR/SAM Regions in order to provide an assessment of the composition of the traffic in this area. Accordingly, States providing air traffic services in that portion of the CAR/SAM Regions agreed to collect traffic movement data for the period of 01-15 July 2005.

2.29 This traffic sample is necessary to facilitate the readiness and safety assessments for the planned RNAV RNP implementation. The States concerned were noted to be those located in CAR/SAM Regions.

2.30 The meeting noted that traffic movement data for operations in CAR/SAM airspace which was received by CARSAMMA prior to August 2005. Some data, due to the format or lack of information could not be treated.

2.31 The total number of flights observed in the traffic samples is 51437. It is necessary to observe that the data from the Brazilian airspace included the traffic flying in the lower airspace.

2.32 Table 1 shows the top 20 operators, in terms of total operations, as observed in the traffic sample. These operators account for roughly 79.49 % percent of the operations observed in the sample. The top 10, representing over 66.1 % of total operations in the data sample, are General Aviation, TAM(TAM), VARIG (VRG), GOL (GLO), State aircraft, American Airlines (AAL), Aerolíneas Argentinas (ARG), Línea Aérea Nacional de Chile (LAN), Companhia Panamericana de Aviación (CMP) and LAN Express (LXP). Analysis of the FIR samples shows that commercial operators conducted roughly 80% of operations, with general aviation operators responsible for 15.79% and state operators responsible for 3.72% of operations.

COMPANY	TOTAL	%	% CUM.
GA	8120	15,79	15,79
TAM	7278	14,15	29,94
VRG	5313	10,33	40,26
GLO	4394	8,54	48,81
State ACFT	1912	3,72	52,52
AAL	1720	3,34	55,87
ARG	1606	3,12	58,99
LAN	1426	2,77	61,76
CMP	1324	2,57	64,34
LXP	1270	2,47	66,81
COA	898	1,75	68,55
LPE	887	1,72	70,28
TAI	856	1,66	71,94
TTL	723	1,41	73,35
AUT	718	1,40	74,74
LRC	557	1,08	75,82
BRB	549	1,07	76,89
TIB	452	0,88	77,77
ONE	452	0,88	78,65
DAL	430	0,84	79,49

Table 1. Top 20 Operators Observed in CAR/SAM Airspace Traffic Sample Presented in Rank Order

2.33 The distribution of the top 20 aircraft types is shown in Table 2. The top 20 aircraft types account for roughly 78.64 % of the operations in the traffic sample. The top seven aircraft types representing over 52.12 % of the operations in the combined FIR samples are: A320, B737, B733, A319, B732, B767 and F100.

TYPE	TOTAL	%	% CUM.
A320	6384	12,41	12,41
B737	5920	11,51	23,92
B733	3969	7,72	31,64
A319	2893	5,62	37,26
B732	2799	5,44	42,70
B767	2606	5,07	47,77
F100	2237	4,35	52,12
B738	2170	4,22	56,34
B757	1736	3,38	59,71
B727	1170	2,27	61,99
E120	1153	2,24	64,23
AT43	1139	2,21	66,44

TYPE	TOTAL	%	% CUM.
MD80	978	1,90	68,34
E110	969	1,88	70,23
B735	909	1,77	71,99
C208	839	1,63	73,63
A340	764	1,49	75,11
PA34	613	1,19	76,30
MD11	602	1,17	77,47
B777	598	1,16	78,64

Table 2. Top 20 Aircraft Types Observed in CAR/SAM Airspace Sample Presented in Rank Order

2.34 Table 3 shows the flight level utilization for those flights with flight level data. Aircraft operating in the Brazilian lower airspace were considered in the analysis.

FL	TOTAL	%	% CUM.
340	6261	9,37	9,37
370	6165	9,22	18,59
330	5742	8,59	27,18
350	5730	8,57	35,75
360	5140	7,69	43,44
380	3762	5,63	49,06
320	3697	5,53	54,59
310	2598	3,89	58,48
300	2430	3,63	62,12
390	2412	3,61	65,72
280	2270	3,40	69,12
270	2192	3,28	72,40
400	1849	2,77	75,16
290	1683	2,52	77,68
410	1094	1,64	79,32
250	920	1,38	80,69
90	749	1,12	81,81
200	736	1,10	82,92
260	720	1,08	83,99
180	695	1,04	85,03

Table 3. Flight Level Utilization in CAR/SAM Airspace Sample

2.35 In general terms, the analysis of the samples indicates that roughly 80 percent of operations were conducted by commercial operators, with general aviation aircraft and state operators accounting for roughly 20 percent of the operations.

2.36 20 operators including GA and State aircraft accounted for roughly 80 percent of total operations in the traffic sample, with the top ten of these operators responsible for slightly more than 66 percent.

2.37 20 aircraft types accounted for roughly 79 percent of total operations in the traffic sample, with the top seven aircraft types accounting for over 52 percent of the operations in the sample.

2.38 Some samples reached CARSAMMA in a different format than the one agreed upon. In view of the above, the States and International Organizations were requested once again to send the information, on the next sample on the dates and, mainly, in the format agreed upon, which facilitates the processing of the information.

Infrastructure required for the implementation of the RNP concept in the CAR/SAM Regions

2.39 CARSAMMA provided a summary of the required infrastructure to implement the RNP concept and of the errors associated with the possible NAVAIDS to be used to provide the navigation performance.

2.40 It was observed that the knowledge of the infrastructure is one of the main aspects during the process of definition of the RNP type to be implemented.

2.41 Also, it was seen that the avionics assume some limits to the amount of error for each available means of navigation.

2.42 The correct definition of the RNP type to be applied is a key issue in the safety assessment of the system.

2.43 It was also noted that before RNP implementation, the States should comply with the WGS-84 system and maintain the NAVAIDS operating properly.

2.44 In view of the above, and given the importance of this matter, it was agreed to include the document as **Appendix E** to this part of the report, introducing development modifications in order to harmonize the terminology with the new RNP concept.

RNAV/RNP Implementation Task List for Enroute Operations / Lista de Tareas para la Implantación RNAV/RNP para Operaciones en Ruta				
ID		Start/Inicio	Finish/Termina	Resource Names/Nombres Recursos
1	Identify Operational Need / Identificar necesidades operacionales			
2	Develop operational concept for CAR/SAM RNAV/RNP /Desarrollar el concepto operacional RNAV/RNP CAR/SAM			
3	Conduct Cost Benefits Analysis / Conducir un análisis costo/Beneficio			
4	Conduct preliminary cost benefit analysis/ Conducir un análisis costo/beneficio			
5	Finalize cost benefit analysis / Finalizar análisis costo/beneficio			
6	Safety Assessment/Evaluación de Seguridad			
7	Review available summary data (non-compliant aircraft, aberrant aircraft etc) / Revisar resumen de datos disponible (aeronaves que no cumplen, aeronaves anómalas, etc)			
8	Examine history of errors related to ATC clearances and assess possible RNAV/RNP impact /Examinar la historia de los errores relacionados con autorizaciones ATC y valorar el impacto posible en la RNAV/RNP			
9	Confirm RNAV/RNP risk model assumptions/parameters are consistent with airspace where RNAV/RNP is to be applied/Confirmar que modelos de supuestos parámetros de riesgo RNAV/RNP sean consistentes con el espacio aéreo en donde se aplicará RNAV/RNP			
10	Carried out the analysis to predict occupancy after RNAV/RNP implementation/ Efectuar el análisis para predecir la ocupación después de la implantación RNAV/RNP			
11	Report large lateral deviations to monitoring agency (including route assignment errors)/Reportar las grandes desviaciones a la agencia de monitoreo (incluyendo los errores de asignación de ruta)			
12	Determinar los mínimos de separación aplicables, basandose en Modelo de Riesgo de Colisión y considerando la infraestructura existente y planificada.			
13	Feasibility Analysis/Análisis de Factibilidad			
14	Examine the general operational factors associated with implementation/Examinar los factores operacionales asociada con la implantación			
15	Determination of Requirements (airborne & ground systems)/Determinación de los Requerimientos (de a bordo y sistemas de tierra)			
17	States assess the impact of RNAV/RNP implementation on ATC automation systems (e.g. equipment suffixes) and plan for upgrades/modifications, including ground facilities/Valoración por parte de los Estados del impacto de la implantación RNAV/RNP en los sistemas de automatización ATC (por ejemplo, sufijos de equipo) y los planes para mejoras/modificaciones inclusive facilidades terrestres			
	Evaluate ground facilities/Evaluar ayudas terrestres			
18	Aircraft & Operator Approval Requirements/Requerimientos de aprobación de aeronave y operadores			
	To develop and armonize the RNAV/RNP implementations including the minimum aircraft system performance specifications (MASPS) considering the available and planned CNS infrastructure/ Desarrollar y armonizar la orientación relacionada con la implantación <u>RNAV/RNP, incluyendo las especificaciones mínimas de la capacidad de los sistemas de aeronave (MASPS), considerando la infraestructura CNS existente y planificada</u>			
19	Promulgate translation of sections of BRNAV//TGL-2 or FAA AC 90-100 into Spanish/Promulgar la traducción de la BRNAV//TGL-2 or FAA AC 90-100			
20	Promulgate the operational approval process/Promulgar el proceso de aprobación operacional			
21	Provide examples of Operations Specifications and Letters of Authority/Proporcionar a los Estados ejemplos de Especificaciones de Operaciones y Cartas de Autorización			
22	Notify States when significant changes occur to RNAV/RNP documentation/Notificar a los Estados cuando haya cambios significativos en la documentación RNAV/RNP			
23	Perform Rulemaking (if required) / Llevar a cabo reglamentaciones (en caso de ser requerido)			
24	Recommend State airspace regulatory documentation/Recomendar al Estado la documentación de reglamentación del espacio aéreo			

RNAV/RNP Implementation Task List for Enroute Operations / Lista de Tareas para la Implantación RNAV/RNP para Operaciones en Ruta				
ID		Start/Inicio	Finish/Termina	Resource Names/Nombres Recursos
25	Perform Necessary Industry & International Co-ordination/Llevar a cabo las coordinaciones con industria e Internacionales necesarias			
26	Establish target implementation date/Establecer una fecha de implantación			
27	Report to ATM/CNS/SG/Reportar al ATM/CNS/SG			
28	Establish format of CAR/SAM RNAV/RNP documentation webpage/Establecer el formato de documentación de la página web RNAV/RNP CAR/SAM			
29	Develop regional documentation and its harmonization/Desarrollar documentación regional y su armonización			
30	Publish advance AIC / NOTAM/ Publicar un AIC / NOTAM adelantado			
31	Publish AIP Supplement containing RNAV/RNP policy/procedures/Publicar el Suplemento del AIP que contenga las políticas/procedimientos RNAV/RNP			
32	Review inter-facility coordination procedures/Revisar los procedimientos internos para la coordinación de la instalación			
33	Finalize airspace changes, if applicable/Finalizar los cambios en el espacio aéreo, cuando sea aplicable			
34	Finalize changes to Letters of Agreement/Finalizar los cambios a las Cartas de Acuerdo			
35	Approval of Aircraft & Operators / Aprobación de la aeronave y los operadores			
36	Identify readiness status of the regional fleet/Identificar estado de preparación de la flota de la región			
37	Assess actual readiness of operators/Evaluar el estado de preparación actual de los operadores			
38	Develop Pilot & ATC Procedures /Desarrollar procedimientos para pilotos y ATC			
39	Review application of tactical offset procedures/Revisar aplicación de los procedimientos tácticos de desplazamiento lateral			
40	Periodically review developments regarding actions for ACAS/TCAS Resolution Advisories that affect RNAV/RNP operations/Revisar periódicamente los desarrollos con respecto a las acciones para las Avisos ACAS/TCAS para operaciones RNAV/RNP			
41	Process Doc 7030 amendment including ATC and pilot procedures/Procesar la Enmienda al Doc. 7030 para los procedimientos meteorológicos y de contingencia			
42	Publish appropriate ATC policy & procedures on RNAV/RNP website/Publicar las políticas y procedimientos ATC en la página Internet del RNAV/RNP			
43	Report procedures to accommodate non-RNAV/RNP domestic aircraft, if applicable/Informar los procedimientos para acomodar las aeronaves domésticas sin aprobación RNAV/RNP, cuando sea aplicable			
44	Identify transition areas and procedures/Identificar las áreas y los procedimientos de transición			
45	States conduct ATC simulations to identify workload/operational factors, if necessary, and report results to ICAO regional offices/Que los Estados conduzcan simulaciones ATC para identificar la carga de trabajo/factores operacionales, si es necesario e informen los resultados a las Oficina Regionales de la OACI			
46	Publish report on ATC simulation activity/Reportar las actividades de las simulaciones			
47	Provide procedures for handling non-compliant aircraft (inc ferry & mtce) in ATS documentation/Proporcionar procedimientos para manejar aeronaves que no cumplen (incluyendo ferry y mantenimiento) con la documentación ATS			
48	Provide mutually acceptable ATC procedures for non-approved State/humanitarian/ferry/maintenance acft to transit RNAV/RNP airspace/Proporcionar los procedimientos ATC de aceptación mutua para las aeronaves de Estado/humanitario/ferry/mantenimiento no aprobadas para transitar en el espacio aéreo RNAV/RNP			
50	Liaise with State defense authorities regarding military operations/Mantener una relación con las autoridades de defensa de los Estados en relación con las operaciones militares			
51	Pilot, Maintenance, Dispatchers & ATC Training/Entrenamiento de Pilotos; Mantenimiento, Despachantes y ATC			
52	Provide ATC training documentation to States/Proporcionar la documentación de capacitación ATC a los Estados.			

RNAV/RNP Implementation Task List for Enroute Operations / Lista de Tareas para la Implantación RNAV/RNP para Operaciones en Ruta				
ID		Start/Inicio	Finish/Termina	Resource Names/Nombres Recursos
53	Conduct local RNAV/RNP training for air traffic controllers/Conducir capacitación RNAV/RNP local para los controladores de tránsito aéreo			
	Provide training guidance material for dispatchers and maintenance personnel/suministrar guías de orientación para entrenamiento de despachantes y personal de mantenimiento			
54	Perform System Verification/Llevar a cabo una verificación del sistema			
55	Lateral keeping performance monitoring needed to undertake initial safety analysis/Monitoreo del performance de navegación lateral necesario para llevar a cabo el análisis inicial de la seguridad.			
56	Provide representative traffic movement data to monitoring agency (30 day sample, repeated annually)/Proporcionar la información representativa del movimiento de tránsito a la Agencia de Monitoreo (muestra de 30 días, repetida anualmente)			
58	Undertake initial safety analysis/Llevar a cabo un análisis inicial de seguridad			
59	Prepare/maintain regional status report detailing RNAV/RNP implementation plans/Preparar/mantener un reporte regional de status detallando los planes de implantación RNAV/RNP			
60	Final Implementation Decision /Decisión para la implantación final			
61	Report status of implementation to GREPECAS /Reportar el estado de implantación al GREPECAS			
62	Review aircraft lateral performance and operational errors/Revisar el estado de la performance lateral de las aeronaves y errores operacionales			
63	ATS State documentation complete/Documentación del ATS del Estado terminada			
64	Publish trigger NOTAM/Publicación de "trigger" NOTAM			
65	Complete operational readiness assessment/Completar la evaluación de disponibilidad operacional			
66	Complete safety analysis/Completar el análisis de seguridad			
67	Declare Initial Operational Capability/Declarar la capacidad operacional inicial			
68	Monitor System Performance/Monitorear la performance del sistema			
69	Perform follow-on monitoring/Llevar a cabo el monitoreo de seguimiento			
70	Declare Full Operational Capability/Declarar la capacidad operacional completa			

APPENDIX B**ACTION PLAN MODEL FOR IMPLEMENTATION OF RNAV-RNP IN TMA**

Activities	Responsible Area	Initiation Date	Finalization Date	Application Status	Remarks
1. Approval of the Action Plan for implementation of RNAV-RNP in TMA	GREPECAS				
2. Identification of operational need.	States				
3. Study of impact in the airspace.	States				
4. Establishment of RNAV-RNP approval procedures.	States				
5. Analysis of cost-benefit considering: -ATS Service Providers; and -Users.	States / Users				
6. AIC for information dissemination.	States				
7. Develop Regional Documentation.	GREPECAS States				
8. Coordination with ATS service providers and users.	States				
9. Establishment and maintenance of an approved aircraft registry.	CARSAMMA States				

Activities	Responsible Area	Initiation Date	Finalization Date	Application Status	Remarks
10. Establishment of a minimum amount of RNAV/RNP approved aircraft before trial initiation.	States				
11. Programme for airspace safety evaluation.	States				
12. Programme for collecting information for safety evaluation and operational availability.	States and Users				
13. Publication of an AIC informing the aeronautical community of the introduction of procedures and requirements.	States				
14. Publication of an AIP Supplement with applicable procedures and requirements.	States				
15. Notification to CARSAMMA of RNAV/RNP approved Aircraft.	States				
18. Conduct local RNAV/RNP training for air traffic controllers.	States				

Activities	Responsible Area	Initiation Date	Finalization Date	Application Status	Remarks
19. Evaluation of applicable minimum separation, using Collision Risk Models, considering available and planned CNS infrastructure.	States				
19. Evaluation of the Preliminary Operational Safety.	States				
21 Evaluation of the Final Operational Safety.	States				
22 Evaluation of Operational Availability.	States				
23. Decision to continue or postpone pre-operational trials.	States				
24 Date for RNAV/RNP in TMA implementation	States				

APPENDIX C

RNAV AND/OR RNP QUESTIONNAIRE

The objective of this survey is to:

- i) Collect information of the available CNS infrastructure in each State of the CAR/SAM Regions, with the corresponding coverage;
- ii) Collect information related with the aircraft fleet operating the ATS Route Network of the CAR/SAM Regions and their RNAV and/or RNP capacity;
- iii) Find out administrations' plans on RNP Implementation and their airworthiness and operations approval capacity;
- iv) Find out airports that could obtain operational benefits by using RNAV and/or RNP for approach and instrument exit procedures and those airports that already have these procedures;
- v) Find out the WGS-84 implementation status in each States of the CAR/SAM Regions;
- vi) Collect existing SID and STARs information in each State of the CAR/SAM Regions, connecting the International Airports to the ATS Routes.

This information would allow the RNAV/RNP Task Force (RNAV/RNP/TF) of the ATM Committee of the GREPECAS ATM/CNS Subgroup to develop the road map.

Mark with a cross the corresponding answer. If required or if you consider pertinent, you could include comments. If necessary, use additional sheets.

1. Report the VHF and VOR antennas, DME equipment and radars (primary and secondary) location to FL 250 with each equipment coverage, hours of service, as well as applied monitoring systems. Attach the coverage chart of this equipment. Use the following table as an example:

Equipment	Location	Geographical Coordinates	Coverage	Monitoring Hours
DME XXX	Brasilia Airport	220 10' 20''N/0450 10' 20''W	120 NM	
Primary and Secondary Radar XXXXX	xxxxxxx (City)	220 10' 20''N/0450 10' 20''W	Primary Radar – 120 NM Secondary Radar – 200 NM	
VHF Antenna	xxxxxxx (City)	220 10' 20''N/0450 10' 20''W	80 NM	

Table 1

2. Report the location of new planned equipment, scheduled implementation dates, with the corresponding coverage of each. Attach the coverage chart of this equipment. Use the following table as an example:

Equipment	Planned Location	Planned Geographical Coordinates	Planned Coverage
DME XXX	Brasilia Airport	220 10' 20''N/0450 10' 20''W	120 NM
Primary and Secondary Radar XXXXX	xxxxxxx (City)	220 10' 20''N/0450 10' 20''W	Primary Radar – 120 NM Secondary Radar – 200 NM
VHF Antenna	xxxxxxx (City)	220 10' 20''N/0450 10' 20''W	80 NM

Table 2

3. Does your administration have the capacity and/or experience in RNAV and/or RNP airworthiness and operational approvals? If yes, please indicate the experience obtained and the reference documentation which has been used.

YES

NO

Comments

4. Is any airport or airspace under your State management that can benefit with the RNAV and/or RNP implementation, taking into account the need of applying reduced horizontal separations between aircraft and/or between aircraft and obstacles? If affirmative, indicate the airspace(s) and its(their) foreseen RNAV criteria and/or RNP value(s). Has your Administration planned the application of RNAV/RNP concepts in those airspaces?

YES

NO

Comments

5. Has your Administration data on aircraft operating in the airspace under its jurisdiction that have RNAV and/or RNP capacity? If affirmative indicate the aircraft fleet and the approved RNAV criteria and/or RNP value(s). Use the following table as an example:

Operator	Type of Aircraft	Registration	RNAV/AFM Capacity		Primary GPS TSO C129		On board confinement alarm capacity	FMS	
			5	2	Single	Dual		Single	Dual

Instructions to fill the table.

1. In the first row of the column entitled "Operator" write the name of the operator, for example: CONDOR.
2. In the column entitled "type of aircraft" indicate the type of aircraft, as per ICAO's designation (B732, B733, B763, etc).
3. In the column entitled "Registration", enter the registration of each aircraft.
4. In the column entitled "RNAV/AFM capacity", mark with a Yes or No whether the aircraft has RNAV capacities with 5 and/or 2 NM confinement values, as indicated in the Airplane Flight Manual (AFM) (FAA) or in the Flight Manual (FM) (JAA) or in the Pilot Operating Handbook (POH) (General Aviation). This column should reflect only the capacity demonstrated in manufacturing and not necessarily the one that has operational clearance of his administration.
If the AFM indicates capacity for RNAV 1 or PRNAV, it should be considered valid in the option RNAV 2.
If the AFM indicates capacity for BRNAV, it should be considered valid in option RNAV 5.
5. In the column entitled "Primary GPS TSO C129", mark with a Yes or No whether the aircraft has single or dual GPS equipment, certificates such as primary navigation equipment that comply TSO C129 () requirements or other TSO/JTSO equivalent.
6. In the column entitled "On board confinement alarm capacity" enter a Yes in case the aircraft has such capacity or a o in case the same is not available.
7. In the column entitled "FMS" mark a Yes in the columns single or dual, as required, in case the aircraft has FMS or with a No, in case there is no FMS.

Note: Following is an example on how to fill in the table:

Operator	Type of Aircraft	Registration	RNAV/AFM Capacity		Primary GPS TSO C129		On board confinement alarm capacity	FMS	
			5	2	Single	Dual		Single	Dual
CONDOR	A320	CC-MEL N-325LA	Yes	No		Yes	Yes Yes		Yes
			Yes	Yes		Yes		Yes	
	B737	BB-2345 BB-0987	Yes	Yes		Yes	Yes Yes		Yes
			Yes	No		Yes		Yes	
	B732	AA-OCC AA-UNE	Yes No	No No	Yes		No No	Yes No	No No

YES

NO

Comments

6. Has your Administration implemented the World Geodetic System 1984 – WGS 84 in the airspace and aerodromes under its jurisdiction, in accordance with ICAO Annex 11, Appendix 5? If negative, indicate the date foreseen for the implementation. If partially implemented, indicate the status of implementation.

YES

NO

PARTIALLY

Comments

7. Are SID and STAR RNAV and/or RNAV approaches implemented to link ATS routes to International and/or Domestic Aerodromes? If affirmative, which were the criteria (documentation) applied in the SID and STAR development (ICAO – Doc 8168, FAA, EUROCONTROL). If no, which are your administration’s plans in this regard?

YES

NO

PARTIALLY

Comments

- 8. Do you deem necessary the holding of seminars, workshops, and courses on:
 - a) airspace planning?
 - b) approach procedures constructions, based in Amendment XX to Doc 8168 (PANS/OPS)?
 - c) aircraft approval and aircraft certification?
 - d) safety assessment and airspace monitoring?

Comments

APPENDIX D**CAR/SAM ROAD MAP FOR RNAV/RNP IMPLEMENTATION**

Phase 1:	Deadline for coordination:	15 December 2005
Phase 2:	Draft Doc.	16 January 2006
Phase 3:	Consolidated Document	28 February 2006

Chap N°	Chapter Title	Content	Responsible for development
	Table of Contents		Secretariat
	Executive Summary		Secretariat
	Explanation of Terms		Secretariat
	Acronyms		Secretariat
	Background		Secretariat
	Introduction	Need for a road map Scope Objectives Principles Self-explanatory	Julio Pereira
	RNAV/RNP concepts	RNAV RNP It is expected that new RNAV and RNP concepts be briefly developed in this chapter, based on the works being developed by the RNPSORSG and documentation and presentations of RNAV/RNP Seminar	Julio Pereira
	Benefits of Performance based navigation	The benefits foreseen both for RNAV and RNP are expected to be included in this chapter	Roberto Arca
	CAR/SAM Regions air traffic forecast	Information related with current air traffic volume and short, mid and long-term forecasts would be included	Fredy Nuñez Secretariat
	Performance-based navigation implementation	Short, mid and long-term en-route operations. An implementation strategy is expected to be included in terms indicated for en-route operations.	Julio Pereira José Moreno COCESNA
		Short, mid and long-term Approach operations. An implementation strategy is expected to be included in terms indicated for terminal area operations.	José Moreno Saulo da Silva COCESNA
		Short, mid and long-term Approach operations. An implementation strategy is expected to be included in terms indicated for approach operations.	José Moreno Saulo da Silva COCESNA

Chap N°	Chapter Title	Content	Responsible for development
	OPS/AIR Requirements	Users requirements ATM requirements Regarding users, it is expected to include documentation in which operational approval and certification will be included, as well as training to crews, dispatchers, etc.	Andrés Prado Aldo Escobar Juan Lobrich Marcelo Ureña Jorge Álvarez Pablo Carranza
	ATM requirements	With regard to ATC requirements, it is expected to include means and necessary requirements to be able to implement RNAV/RNP, and the process to be followed, as well as personnel training. An action plan (or road map) could be one of the requirements.	Roberto Arca Mario Sardiña José Mondragón Rodolfo Cárdenas
	Risk assessments	Safety assessment. Under this item, it is expected to include all necessary elements and pertinent procedures to determine that RNAV/RNP implementation will be safe and complies with established safety parameters.	Saulo da Silva
	Post-implementation activities	System monitoring The procedures required will be defined to carry out a continuous monitoring of operational safety once RNAV/RNP is implemented.	Saulo da Silva
	Appendix X1	TBD	
	Appendix X2	TBD	

Reference material

RNPSORSG/5 Report. FAA Road Map, Navigation Strategy Eurocontrol, Industry Road Map. Global ATM Concept, ATM initiatives, CAR/SAM ANP and FASID, CAR/SAM CNS/ATM Transition Documents.

APPENDIX E

INFRASTRUCTURE REQUIRED TO IMPLEMENTATION OF THE RNAV/RNP CONCEPTS IN THE CAR/SAM REGIONS

1. Introduction

1.1. The Caribbean and South American Air Navigation Planning and Implementation Regional Group (GREPECAS) established the Caribbean and South American Monitoring Agency (CARSAMMA) as a safety oversight function to support RVSM/RNP implementation in the Caribbean and South American Region. The CARSAMMA is a service provided by the Brazilian Air Navigation Management Center.

1.2. Along with maintaining a registry of State RVSM/RNP approvals of operators and aircraft using CAR/SAM airspace, the CARSAMMA will produce readiness and safety assessments in conjunction with the Safety and Airspace Monitoring (SAM) Working Group of the RNAV/RNP Task Force.

1.3. The CARSAMMA will apply the internationally accepted safety assessment process with the introduction of the RNAV/RNP into CAR/SAM airspace. The basic collision risk model (CRM) will be used to estimate the overall system risk attributable to all causes prior to implementation of the RNAV/RNP. To define the separation minima that will be applied in the airspace of the CAR/SAM region, and that will affect the safety level, one of the tasks is to verify the infrastructure available in support of the navigation in the airspace where is or will be planned the implementation.

1.4. The International Civil Aviation Organization (ICAO) has recognized a need for dramatic improvements to the existing air navigation system. To obtain the benefits of the CNS/ATM concept, aircraft will need to achieve accurate, repeatable and predictable navigation performance. This is referred to as Required Navigation Performance (RNP).

1.5. The purpose of this paper is to present a summary of navigation system requirements and infrastructure characteristics in connection with the implementation of the RNAV/RNP concepts in the CAR/SAM airspace.

2. Background

2.1. A navigation system with the infrastructure addressed in this WP provides the functions of position estimation, path definition, path steering, and situation indications and alerting to the flight crew. The system may also provide the optional speed control function to support Vertical Navigation and Time of Arrival Control. These functions and the operational interface to the system affect the level of navigation performance that can be achieved. This paper provides a general description of the infrastructure required and explains the relationship between the various errors of the navigation system.

2.2. Position estimation is a means of determining the aircraft's position over the surface of the earth. Data is used, either from radio sensors (with signals from ground-based NAVAIDS or from satellites) or from onboard autonomous navigation sensors, to derive an estimated position. The position estimation function obtains information concerning any ground-based Navaids that are being used from a navigation database. An important consideration for the aircraft system is that most air transport aircraft incorporate multi-sensor navigation systems. Such systems can utilize the information simultaneously from various

available aids such as VOR, DME, GPS and IRU, to provide the best estimated position and aid in continuity of performance. The function also provides position data for display of parameters such as estimated position, estimate of position uncertainty, ground speed and track angle, based on the sensor data being processed.

2.3. The future CNS/ATM operating environment is expected to be based on navigation defined by geographic fixes. Routes and instrument procedures will not be restricted to the location of ground-based navigation aids. This concept, known as Area Navigation (RNAV), is not new. The critical benefit of RNAV is that it eliminates the strict dependency on over-flight of ground NAVAIDS, thus aiding flexibility in the designation of routes and procedures. However, an element that has been missing is the level of confidence of navigation accuracy in flying such routes and procedures. The standards defined in the MASPS integrate the concepts of Required Navigation Performance with that of Area Navigation to provide this level of confidence.

2.4. The RNP concept as written in the ICAO Manual also states:

While the navigation performance accuracy is the basis for defining an RNP type, the other navigation performance parameters of availability, coverage, reliability, capacity, time to recover and integrity determine the utilization and limitations of the individual navigation systems, both ground and airborne, and characterize the means by which a user derives navigation information within an RNP type airspace, as described in this paper. Numerical values for these parameters will be quantified by the appropriate technical bodies.

2.5 Work is in progress in the ICAO respective bodies. One expected product is a new manual that will update the concepts of the RNP Manual, as well as provide implementation guidance for States. It is expected that this new manual will address many of the points discussed here, as well as many others.

2.6 It must be reminded that All navigation data published by a State is assumed to be referenced to the WGS-84 earth model in accordance with ICAO Annex 15 for lateral and precision landing path points. All altitude data will be referenced to the MSL geoid and standard atmospheric pressure model.

3. Discussion

3.1 This section describes one consensus on the sensor performance that is assumed to be provided by each type of navigation facility if it is to be used to promulgate a route for RNP RNAV, and with Vertical Performance requirements, where appropriate. This performance must be assumed by the aircraft when demonstrating compliance to the system requirements. It is also provided information for the airspace planner in assessing what RNP RNAV types may be supported by a particular navigation infrastructure.

3.2 Integrity of the infrastructure is not considered as part of the airborne evaluation; the Signal-in-Space (SIS) are assumed to have the error distributions described below. The only exception is GPS, which has a SIS failure rate that must be compensated by an augmentation.

3.3 Infrastructure continuity is not considered as part of the airborne evaluation, but must be considered by the State prior to defining RNP RNAV airspace predicated on a particular navigation infrastructure. It is assumed that an RNP RNAV operation will not be initiated unless the SIS continuity is sufficient.

3.4 In addition, it is assumed that the State publishes the correct location for each navigation facility, so that any error arising from inaccurate survey of a navigation facility is consistent with the following

accuracy assumptions.

3.5 This guidance was developed with two purposes. One was to establish a generalized baseline of aircraft performance and capability. In doing so, the requirements do not consider all possible implementations and the potentially better levels of performance that can be achieved. The second purpose was to enable the State to focus on the types of NAVAIDS in their infrastructure, including numbers, locations, and their ability to support performance required.

3.6 Navigation Facility Assumptions for the Airborne System

3.6.1 VHF Omni-directional Range (VOR)

The basic expression for VOR accuracy is:

$$\sigma_{VOR}^2 = (\sin(\text{GS error}) * D)^2 + (\sin(\text{airborne error}) * D)^2$$

where

GS error = ground station alignment and bend error,

D = distance to the VOR, and

airborne error = standard deviation of airborne error, including receiver noise

When demonstrating compliance to the MASPS, the airborne system shall assume that the VOR infrastructure will provide a radial signal with a Gaussian angular error that has a mean of zero and a standard deviation of 0.7 degrees. VOR signals shall not be used at ranges greater than defined in the table below.

Range	max. D
NP-0.3 to RNAV RNP 0.9	20 NM
RNAV RNP-1 to RNAV RNP-1.9	40 NM
RNAV RNP-2 and above	100 NM

Table 1 - Maximum VOR Ranges

When designating RNAV RNP airspace based upon a VOR infrastructure, the State may assume that the VOR contribution to error (in the perpendicular direction from the track to the VOR) is equal to:

$$\sigma_{VOR}^2 = (0.0122 * D)^2 + (0.0175 * D)^2$$

Note: This assumes that VOR equipment has an airborne error contribution of 1 degree (95%).

VOR facilities are assumed to have a mean time between failures of 10,000 hours.

3.6.2 Distance Measuring Equipment (DME)

The basic expression for DME error is:

$$\sigma_{DME}^2 = (\text{GS Error})^2 + (\text{Air Error})^2 + (K \cdot D)^2$$

where

GS Error = ground station timing error
 K = constant
 D = distance to the DME

When demonstrating compliance to the MASPS, the airborne system shall assume that the DME infrastructure will provide a ranging signal with a Gaussian slant range error that has a mean of zero and a standard deviation of 0.05 NM. DME signals shall not be used at ranges greater than defined in the table below.

Range	max. D
RNAV RNP-0.3 to RNAV RNP 0.9	25NM
RNAV RNP- 1 to RNAV RNP- 1.9	55 NM
RNAV RNP-2 and above	140 NM

Table 2 - Maximum DME Ranges

Note : The DME range error will be less than 0.2 NM (95%) for systems installed after 1 January 1989 (ICAO Annex 10). Before this date, accuracy was addressed in Annex 10 as a recommended 0.25 NM + 1.25% indicated range.

When designating RNAV RNP airspace based upon a DME infrastructure, the State may assume that the DME contribution to error (slant-range to the DME) is equal to:

$$\sigma_{DME}^2 = (0.05 \text{ NM})^2 + \text{MAX} \{ (0.085)^2, (0.0125 * D)^2 \}$$

DME facilities are assumed to have a mean time between failures of 10,000 hours.

3.6.3 Inertial Reference System (IRS)

Since an IRS is not dependent upon external signals, no external error allocation is necessary.

3.6.4 Global Positioning System (GPS)

When demonstrating compliance to the MASPS, the airborne system shall assume that the GPS infrastructure will provide a signal with a Gaussian pseudo-range error that has a mean of zero and a standard deviation of 33 meters.

When establishing compliance to the containment requirements, GPS satellites shall be assumed as having a major service failure rate of 10^{-5} /hour/satellite. A major service failure is defined to be a pseudo-range error greater than 150 meters received from a satellite not designated "unhealthy". The overall failure rate shall also be assumed to be 10^{-5} /hour/satellite (the failure rates are equivalent because the major service failure rate is conservative).

Note: GPS provides a unique signal-in-space in that it is not directly monitored to a level commensurate with aviation requirements (time-to-alarm and probability of missed detection). In order to use GPS for IFR navigation, augmentation is required to provide the monitoring function [airborne augmentation such as fault detection and exclusion (FDE), space-based augmentation, or ground-based augmentation]. The requirements for the augmentation must be based upon the potential effect of a GPS satellite failure on multiple users. These requirements will be determined for each type of augmentation, and will be more stringent than that required to satisfy the containment requirements of a single aircraft. For GPS systems using FDE as the requisite augmentation, the probability of missed detection and failed exclusion have both been established as 10^{-3} (RTCA/DO-229, FAA Notice 8110. 60).

Note: As implementation of RNP proceeds, it should be recognized that the assessment of performance and capability, and the approval will consider the total system. The total system i.e. multiple sensors and navigation computer will be evaluated in determining how continuity of performance and integrity is provided in the event of sensor failure and loss of signal in space, as described further in 3.7.3

3.7 Effect of Position Estimation Error (PEE) to Route or Procedure Airspace Design

It is assumed that RNAV RNP procedures will not be developed unless the navigation infrastructure supports the procedure. In order to assess whether or not a particular infrastructure supports RNAV RNP-(x), the State will identify the desired RNAV RNP type and assess the feasibility of the desired RNAV RNP type. The assessment of feasibility involves the following steps:

- 1) Determine the maximum σ_{PEE} that supports the desired type: $\sigma_{PEE} = 0.3(x)$,
- 2) Identify the navigation facilities which support the σ_{PEE} , selecting at least one type of airborne integration, and
- 3) Assess continuity of the selected navigation infrastructure.

These steps are discussed in detail below. Alternatively, the entire process can be reversed by assessing a particular navigation infrastructure and determining the RNAV RNP type that it supports.

3.7.1 Determine Maximum σ_{PEE} The maximum standard deviation of position estimation error is defined as

$$\text{MAX } \{ \sigma_{PEE} \} = 0.3(\text{desired RNP Value})$$

By allocating a fraction of the allowable total system error to the signal-in-space, the remaining error budget is allocated to the aircraft. The value of 0.3 was based upon an evaluation of reasonable airborne errors, so that the effective error allocation is:

$$\sigma_2$$

$$\text{TSE} = \sigma_{PEE}^2 + \sigma_{PSE}^2$$

$$(\text{RNP Value})^2 = (2*0.3*\text{RNP Value})^2 + (0.8*\text{RNP Value})^2 ,$$

where the path definition error is assumed to be zero for this feasibility assessment. The aircraft has been allocated an error of $2 \sigma_{PSE} = 0.8 * \text{RNP Value}$.

3.7.2 Identify Navigation Facilities Which Provide Required Accuracy

The State should identify the facilities within range of the intended procedure. Because the airborne equipment assumes that the SIS have the characteristics defined in this paper, the State must also use these assumptions in assessing the RNAV RNP type supported by an infrastructure. The past section provides sufficient information to determine the error distribution for each navigation aid. These error distributions are combined depending upon the type of airborne integration. The following assumptions provide a reasonable baseline for the resulting standard deviation of PEE (in the worst-case cross-track dimension). Additional types of airborne integrations may be specified as appropriate.

Collocated VOR/DME Position

$$\sigma_{PEE}^2 = \sigma_{VOR}^2 + \sigma_{DME}^2$$

DME/DME Position

$$\sigma_{PEE}^2 = (\sigma_{DME,1}^2 + \sigma_{DME,2}^2) / \sin^2(\alpha)$$

where α is the angle between the DMEs.

Note: The effects of slant-range have not been separately considered, based upon the assumption that the error is small for terminal operations and not significant for en route operations.

GPS Position

$$\sigma_{PEE} = 50 \text{ meters}$$

Note: The performance of RNAV RNP systems which utilize GPS is typically constrained by the containment integrity requirement, not the accuracy requirement. While the accuracy is sufficient to support all envisioned RNAV RNP types, it should be recognized that additional augmentation is required to meet the containment requirements with high availability.

3.7.3 Assess Infrastructure Continuity

Depending on the type of facilities provided and the intended operation, the State may elect to have redundant facilities to ensure that the continuity is consistent with air traffic requirements. If multiple facilities are required to satisfy the air traffic service requirements, then the worst-case operational configuration should be used for the assessment in item 3.7.2.

For example, an RNAV RNP procedure may be created based on a DME/DME environment. Although only two DMEs are required to provide navigation, the State may determine that three DMEs are necessary to achieve the desired continuity and account for DME ground station maintenance and failures. In this case, the two DMEs with the worst geometry should be used (the third DME should be assumed to be out of service).

4. **Summary**

4.1. This paper provided a summary of the required infrastructure to implement the RNAV RNP concepts and the errors associated with the possible NAVAIDS to be used to provide the envisaged navigation performance.

4.2. It was seen that the knowledge of the infrastructure is one of the main aspects during the process of definition of the RNAV RNP type to be implemented.

4.3. Also, it was seen that the avionics assume some limits to the amount of error for each available means of navigation.

4.4. The correct definition of the RNAV RNP type to be applied is a key issue in the safety assessment of the system.

4.5. It was verified that the States must be compliant with the WGS 84 system, before the RNAV RNP implementation as well as keep the NAVAIDS working properly.

5. **Recommended actions**

5.1 States are requested to take note of the information provided in this paper as guidance when assessing the RNAV RNP type to be applied.

5.2 The Secretariat is requested to confirm the status of WGS 84 implementation in the CAR/SAM Regions.

5.3 The RNAV RNP TF is requested to create a specific task in its task list related to the definition of the RNAV RNP type to be applied in the en-route structure of the CAR/SAM airspace or in a particular area.

5.4 States are requested to keep their NAVAIDS with the performance required to support the RNAV RNP implementation.

Agenda Item 3: RNAV and RNP issues related with the Aircraft Operation and Airworthiness Working Group (OPS/AIR/WG)

Work Programme of the OPS/AIR/WG and PBN Road Map

3.1 The Meeting analyzed the terms of reference and work programme of the RNAV/RNP Task Force, as well as the work programme of the OPS/AIR/WG, in order to meet the established objectives (See Appendix B to Agenda Item 1).

3.2 It also analyzed the proposed PBN road map and the associated OPS/AIR tasks, taking into account that the task on Users Requirements must be fulfilled by the OPS/AIR/WG.

3.3 Due to the above, it was agreed that the OPS/AIR/WG will propose the documentation to be used by the operators as a basis to obtain operational approval and airworthiness certification. The OPS/AIR experts responsible for the execution of the task are listed in Appendix D to Agenda Item 2.

OPS/AIR-related RNAV/RNP implementation strategy and List of Tasks for RNAV implementation for en route operations

3.4 The Meeting reviewed the strategy prepared by the ATM Committee for OPS/AIR-related RNAV/RNP implementation in the CAR/SAM Regions, and the task list model for RNAV implementation for en-route operations, and made the following amendments:

- a) Item 17: Incorporate the requirements for ground facility improvements within the task of assessing the impact of the implementation
- b) Item 21: Change the term “letters of authority” for “letters of authorization”
- c) Item 29: The drafting of regional documentation should consider its harmonization.
- d) Items 36 and 37: Modify both items as follows:
 - Item 36: Identify the readiness of the fleet of the region.
 - Item 37: Assess the readiness of the operators in the region.
- e) Item 51: In addition to maintenance personnel, flight operations/dispatch personnel should also be included in the training.
- f) Include an item concerning the assessment of the status of ground aids.

3.5 Furthermore, the meeting considered it advisable to compare this list of tasks with that used in other regions that have already implemented performance-based navigation. The numbering should also be verified. (numbers 16, 49 and 57).

RNAV/RNP questionnaire

3.6 The meeting analysed the RNAV/RNP questionnaire from the OPS/AIR point of view and agreed on the need to make the following amendments:

- a) Amendments to questions 1 and 2 were proposed and accepted.
- b) Modification of Table regarding Question 4.
- c) Question 8 was eliminated.

Note: The result of these amendments is shown in Appendix 2C of Agenda Item 2.

Operator	Type of Aircraft	Registration	RNAV/AFM Capacity		Primary GPS TSO C129		On board confinement alarm capacity	FMS	
			5	2	Single	Dual		Single	Dual

Instructions to fill the table.

1. In the first row of the column entitled “Operator” write the name of the operator, for example: CONDOR.
2. In the column entitled “type of aircraft” indicate the type of aircraft, as per ICAO’s designation (B732, B733, B763, etc).
3. In the column entitled “Registration”, enter the registration of each aircraft.
4. In the column entitled “RNAV/AFM capacity”, mark with a Yes or No whether the aircraft has RNAV capacities with 5 and/or 2 NM confinement values, as indicated in the Airplane Flight Manual (AFM) (FAA) or in the Flight Manual (FM) (JAA) or in the Pilot Operating Handbook (POH) (General Aviation). This column should reflect only the capacity demonstrated in manufacturing and not necessarily the one that has operational clearance of his administration.
If the AFM indicates capacity for RNAV 1 or PRNAV, it should be considered valid in the option RNAV 2.
If the AFM indicates capacity for BRNAV, it should be considered valid in option RNAV 5.
5. In the column entitled “Primary GPS TSO C129”, mark with a Yes or No whether the aircraft has single or dual GPS equipment, certificates such as primary navigation equipment that comply TSO C129 () requirements or other TSO/JTSO equivalent.
6. In the column entitled “On board confinement alarm capacity” enter a Yes in case the aircraft has such capacity or a o in case the same is not available.
7. In the column entitled “FMS” mark a Yes in the columns single or dual, as required, in case the aircraft has FMS or with a No, in case there is no FMS.

Note: Following is an example on how to fill in the table:

Operator	Type of Aircraft	Registration	RNAV/AFM Capacity		Primary GPS TSO C129		On board confinement alarm capacity	FMS	
			5	2	Single	Dual		Single	Dual
CONDOR	A320	CC-MEL N-325LA	Yes Yes	No Yes		Yes Yes	Yes Yes		Yes Yes
	B737	BB-2345 BB-0987	Yes Yes	Yes No		Yes Yes	Yes Yes		Yes Yes
	B732	AA-OCC AA-UNE	Yes No	No No	Yes		No No	Yes No	No

National regulation and RNAV and/or RNP approval process

3.7 The meeting reviewed the issue related with the drafting of a national regulation and the approval process, and deemed it advisable to include the relevant sections of working paper 6 as **Appendix A** to this part of the report for future reference.

Required infrastructure

3.8 The group took note of the work carried out by the WG regarding the content of the working paper presented by CARSAMMA related with the required infrastructure and also felt that it should be included as an appendix to the report, for use as reference material. (See Appendix B to Agenda Item 2.)

SID/STAR Implementation

3.9 Considering the importance of having harmonized and integrated procedures in all flight phases, the working group agreed with the other working groups that this issue should be duly considered by States and International Organizations, and urged them to focus their efforts and work in the design of SIDs and STARs to link the existing RNAV routes, in order to have harmonized and integrated procedures in all flight phases.

Data collection carried out by CARSAMMA

3.10 The meeting took note of the information provided by CARSAMMA on the CAR/SAM traffic sample and agreed that States and International Organizations that had not yet done so, should contribute to the collection of the required data.

Training requirements

3.11 The meeting analysed aspects related to the training of personnel involved in performance-based navigation operations. A series of topics were examined and it was felt that the same could be used as guidance material for the assessment of training requirements and the development of training programmes. In this sense, it was agreed that the most important aspects should be included as **Appendix B** to this part of the report.

3.12 During the discussion, the point was raised about the assessment of flight crews operating in aircraft that have obtained their RNAV capability in service, and it was felt that simulators might not have the required capability. Since this matter required further analysis, the group decided to include it in the work programme of the OPS/AIR.

3.13 On the other hand, the meeting, after analysing this matter, agreed to the following:

Conclusion AP/ATM/11/3 - Training of OPS/AIR personnel

That the States and International Organizations take the necessary measures to train OPS/AIR personnel, which in turn should disseminate the knowledge acquired.

APPENDIX A

REFERENCE MATERIAL FOR THE PREPARATION OF A NATIONAL NAVIGATION PERFORMANCE-BASED REGULATION AND PROCESS OF APPROVAL

1. **Proposals of regulations**

1.1 In order to accomplish the RNAV/RNP implementation, it is necessary to have regulations which allow the use of the airspace designated as RNAV/RNP. The regulations to be developed by the Civil Aviations Authorities should take into account the standards prescribed in Annexes 6 and 11 to the Convention on International Civil Aviation, relating to RNAV/RNP operations. In the paragraphs 7.2 – Navigation equipment of Annex 6 and 2.7 of Chapter 2 of Annex 11 – Navigation equipment, the standards relating with RNP are prescribed.

1.2 The following samples of regulations are considered that would be appropriate to regulate the RNAV/RNP operation in the region.

- a) Sections D 1.430 of LAR OPS Part 1, at the present under development and JAR – OPS 1.243 – Operations in areas with specific navigation performance requirements prescribed: An operator shall not operate an airplane in defined areas, or a defined portion of specified airspace, based on Regional Air Navigation Agreements where minimum navigation performance specifications are prescribed unless approved to do so by the Authority (RNAV/RNP Approval).
- b) Sections I 1.970 (d) (2) of LAR OPS Part 1, at the present under development and JAR OPS 1.865 (c) (2) – Navigation equipment prescribes: (d) An operator shall ensure that navigation equipment; (2) Complies with the Required Navigation Performance (RNP) Type for operation in the airspace concerned.

2. **Proposal for a model of a generic process of approval**

2.1. In spite the fact that the types of RNAV/RNP operations have different requirements of containment, equipment and of course training, it is necessary to standardize the procedures in order to issue the RNAV/RNP approval.

2.2. An RNAV/RNP approval consists of two types of approvals: the airworthiness approval and the operational approval, even though, they have different requirements, both must be considered under one process only.

2.3. With the purpose to standardize and provide guidance with steps well defined to the operations and airworthiness inspectors, it is convenient that the process follows the five phases of the generic process of approval, which have been described in the Operations Inspector Manual (MIO) of the SRVSOP.

2.4. The five phases to be considered during the approval process are described below:

- a) Phase one: Pre-application
- b) Phase two: Formal application
- c) Phase three: Analysis of the documentation
- d) Phase four: Demonstration and inspection
- e) Phase five: Approval

2.5. In Phase One of Preapplication, the CAA holds a meeting with the operator (the preapplication meeting), in which the operator will be informed about all the requirements that he needs to comply during the approval process.

2.6. In Phase Two of Formal Application, the operator submits the formal application with all applicable documents.

2.7. In Phase Three of Analysis of the documentation, the CAA reviews the submission and evaluates the navigation equipment in order to determine the method of approval (aircraft equipment eligibility). As a result of this evaluation the CAA may accept or return the Formal Application with the documentation.

2.8. In Phase Four of Demonstration and Inspection, the CAA will observe the validation flights or tests if they are required by its regulations or, if they are not required, then the process advances to the last phase.

2.9. In phase Five of approval, the CAA issues the RNAV/RNP approval, once the operator has completed the airworthiness, continued airworthiness and operations requirements.

APPENDIX B

GUIDANCE MATERIAL ON TRAINING REQUIREMENTS

1.1. First, the need for inclusion of a requirement for regulation in each State, should be assessed, keeping in mind that standardization is to be achieved through the LARs.

1.2. Through the approval of a training programme the content of theoretical initial training as well as the frequency of periodical training, should be analysed. The management of training records and updating method should also be analysed.

1.3. This approval of the training programme is part of the RNAV and RNP approval process and it is considered in the first 4 phases.

1.4. Translation for the word *training* is trying to be standardized to read *instrucción*, as per ICAO. Therefore, the operator should be guided to use this term in when designing their training programmes.

1.5. Within the training challenges the problem of absence of experts should be solved not only within the operators but also in the CAAs.

1.6. The study plan should be “customized” (adapted to each operator), due to the fact that RNAV and RNP operations are based on the identification of the capacities of the aircraft and performance requirements instead of the identification of specific equipment/technology installed on board, and that the study plan depends on the use to be given on the knowledge acquired and of the personnel to be trained.

1.7. Among the common training aspects for AIR and OPS, we may quote the following:

- a) Have a general knowledge of RNAV and RNP application
- b) Standards Requirements
- c) Policies and procedures of the organization – MGO and MGM
- d) Have a thorough knowledge of the equipment and capacities of the aircraft
- e) Be aware of the limitations of the clearance
- f) Human factors
- g) MEL
- h) International harmonization
 - Regional conclusions
 - Review of RNAV and RNP concepts
 - i) Requirement for integrity confinement
 - ii) Guidelines for the uniform implementation of OPS RNP
 - RNAV Development in non-radar environments
 - Content of ICAO Doc. 9613 – revised

1.8. Among the specific training aspects for AIR, we could quote:

- a) Maintenance dispatches, ensuring that necessary equipment requirements are complied for RNAV and RNP operations
- b) Realization of 360° - condition of the navigation and panelling antennas of the fuselage near the antennas
- c) Use of MEL – dispatch restrictions
- d) Training on new equipment installation
 - Data approved and compliance of TSOs
- e) Changes in maintenance programme – ICA
- f) FMS – DB, registries, who updates, etc.
- g) Instrument precision – certified equipment for precision assessment
- h) Necessary training to carry out the RNAV and RNP AIR process of approval:
 - Information submitted with the request – what is acceptable for the CAA.
 - i) Sufficient data so as to enable an assessment of acceptability of the equipment/system in relation to the purpose of its use.
 - ii) Evidence of proofs carried out to demonstrate the navigation performance precision, appropriate for the type of RNP.
 - iii) The information should adequately reflect the aircraft capacity to comply with flight operational requirements, within that airspace assigned.
 - iv) A technical assessment is necessary for changes in the approval of types of RNP.

1.9. The specific training for OPS shall be given as per RNAV or RNP type of operation, and to this end, each operator requests clearance, or is authorized. The document used according to the type of RNAV. The following table (extracted from the final report of the AP/ATM/10 meeting) shows us the relationship:

RNAV			
Airspace	RNAV types	Approval Documentation and Operators	Associated Precision Value
Oceanic/Remote	RNP 10	Doc. 9613 (FAA Order 8400.12A)	10 NM
	RNP 4	Doc. 9613	4 NM
Continental/Terminal	RNAV-5	EUROCONTROL TGL 02	5 NM
	RNAV-2	FAA AC 90-100 (USRNAV Type A)	2 NM
	RNAV-1	EUROCONTROL TGL 10 or FAA AC 90-100 – USRNAV Type B)	1 NM

1.10. Among the specific training aspects for OPS, we could quote:

- a) BRNAV, PRNAV
- b) CRNAV (USRNAV type A and B), TRNAV
- c) History of VOR/DME/ADF safety (reason for the change)
- d) How do RNAV/RNP and GLS work
- e) Alerts to crew (e.g., NAV UNABLE RNP, etc.), and procedures
- f) Approach/trajectories procedures
- g) Selection of approach and execution
- h) Use of automation
- i) Effects of low temperatures and procedures
- j) Effects of equipment failures (loss GPS, FMS, etc.)
- k) Contingency procedures
- l) ATC reporting if doubts in navigation equipment precision
- m) Use of check lists
- n) Flight training, compatible with periodical training (recurrent)
- o) Fly several RNAV or GLS approaches
- p) Approach preparations, RNP configuration
- q) RNAV Transition precisions and holdings
- r) Final RNAV and VNAV approach missed approach
- s) UNABLE RNP alert
- t) Review of common errors
- u) At least one GLS approach to gain confidence; (the abilities already exist)
- v) Approximately 1-2 hours in Simulator by crew (recommendation of Boeing).

1.11. Among specific training aspects for OPS/Dispatch we may quote:

- a) Development of specific procedures for the realization of RNP operations:
 - NOTAMs affecting RNP procedures
 - Evaluation of GPS availability
- b) Filling of flight plan form
 - Example: inclusion of setter R in box 10
- c) Operative Restrictions nes related with RNAV/RNP approval
- d) Calculation of the time limit for each specific flight
 - Consideration of the flight plan

1.12. Among specific training aspects for OPS and ATC we may quote:

- a) Phraseology (unpublished, trying to look like that one developed for RVSM)
- b) Human Factors
- c) Emergency procedures

1.13. In case the operator has an approved training programme, the inclusion of RVSM training courses should be considered as an amendment to this programme. The request of amendment should include at least the content of the course, documentation proving the instructor (depending on the regulations of the state to request or not licences) periods of recurrence duly sustained (time of duration of the recurring course may be reduced), and a tentative date to carry out initial training (the assistance by the CAA is recommended) to evaluate the depth in which each item described in the content of the course is dealt with, and the possibility to cover all the issues in the time proposed).

1.14. A course may be given including different aircraft models, provided that the differences among the different types of aircraft are clearly established in such way to avoid confusions in the personnel which is attending the course.

1.15. For an evaluation of courses based on CBT (computer-based-training) and OJT (on-the-job-training), the procedures established by each CAA should be used.

Agenda Item 4: RNAV/RNP issues related with the Safety and Airspace Monitoring Working Group (SAM/WG)

SAM/WG Work Programme

- 4.1 The meeting analyzed the following papers: WP/02, WP/03, WP/04 and WP/07.
- 4.2 The Meeting also discussed the terms of reference and work programme of the PBN/TF and, on that basis, developed the Terms of Reference of the SAM/WG related to the planning of the implementation of the RNAV and RNP concepts in the CAR/SAM Regions.
- 4.3 After analyzing the proposal submitted by the Secretariat, the SAM/WG, in accordance with the tasks to be accomplished, agreed on its work programme as shown in Appendix C to Agenda Item 1.

Model of task list for RNAV and RNP implementation

- 4.4 The task list proposed by the Secretariat was reviewed by SAM/WG, agreeing to address tasks 6, 7, 8, 9, 10, 37, 55, 58, 62, 65 and 66.
- 4.5 Task 10 was modified to read: “Conduct analysis to predict occupancy after RNAV and RNP implementation.”
- 4.6 The requirement of Task 12, related to the determination of separation minima was also analyzed, and it was agreed that the assignment of this task should wait until future discussions inside the Task Force.

RNAV and RNP questionnaire

- 4.7 In analyzing the proposed questionnaire, the SAM/WG approved it and recommended to modify the first question to include the FL for which the coverage.

Required Infrastructure

- 4.8 The Meeting analyzed the information provided by CARSAMMA regarding the supporting infrastructure of the intended RNAV and RNP types.
- 4.9 It was noted that while the navigation performance accuracy is the basis for defining an RNAV and RNP type, the other navigation performance parameters of availability, coverage, reliability, time to recover and integrity determine the utilization and limitations of the individual navigation systems, both ground and airborne, and characterize the means by which a user derives navigation information within an RNAV and RNP type airspace.

4.10 It was recalled that all navigation data published by a State are assumed to be referenced to the WGS-84 Earth model, in accordance with ICAO Annex 15.

4.11 The Meeting was informed that the infrastructure continuity is not considered part of the airborne evaluation, but must be considered by the State prior to defining RNAV and RNP airspace predicated on a particular navigation infrastructure. It is assumed that an RNAV and RNP operation will not be initiated unless the SIS continuity is sufficient.

4.12 In assessing the infrastructure continuity and depending on the type of facilities provided and the intended operation, the State may elect to have redundant facilities to ensure that the continuity is consistent with air traffic requirements. If multiple facilities are required to satisfy the air traffic service requirements, then the worst-case operational configuration should be used for the assessment.

4.13 In addition, it is assumed that the State publishes the correct location for each navigation facility, so that any error arising from inaccurate survey of a navigation facility is consistent with the accuracy assumptions.

4.14 Considering the effect of Position Estimation Error (PEE) to route or procedure airspace design it is assumed that RNAV/RNP procedures will not be developed unless the navigation infrastructure supports the procedure. In order to assess whether or not a particular infrastructure supports a determined RNAV/RNP type, the State should identify the desired RNAV/RNP type and assess the feasibility of the desired RNAV/RNP type. Alternatively, the entire process can be reversed by assessing a particular navigation infrastructure and determining the RNAV RNP type that it supports.

4.15 It was seen that the knowledge of the infrastructure is one of the main aspects during the process of definition of the RNAV/RNP type to be implemented and considering that the Meeting agreed on the following recommendations.

Decision AP/ATM/11/4 - RNAV and RNP Task Definition

The RNAV RNP TF is requested to create a specific task in its task list related to the definition of the RNAV/RNP type to be applied in the en-route structure of the CAR/SAM airspace or in a particular area.

Conclusion AP/ATM/11/5 - NAVAIDS Performance

That States maintain their NAVAIDS with the performance required to support the RNAV/RNP type to be implemented.

Scrutiny Group (S/WG)

4.16 Due to LHD reports being submitted without proper estimation of duration at incorrect flight level, the Group requires the use of a default value. The Group previously agreed that 90 sec will be used as the default value. This value will be applied to errors of "M" (error in ATC-unit-to-ATC-unit transfer messages) that do not have an estimated duration at incorrect flight level.

4.17 As the 90-second default value a compromise value to be used apply to errors to cover both surveillance and non-surveillance coverage areas, there was further discussion whether if there should be two default values; one for radar surveillance environments and the other for non-radar surveillance environments. The Group did not reach a conclusion, but did unanimously stress the need for complete Altitude Deviation reports. This item will be discussed at subsequent meetings.

4.18 The meeting reviewed and accepted an easier to use Altitude Deviation reporting form. See **Appendix A** to this part of the report.

4.19 ICAO stressed the importance of clear and accurate reporting of LHDs.

4.20 The form will be posted on the CARSAM website in three languages in Word and PDF formats.

- English <http://www.cgna.gov.br/carsam/Ingles/index.htm>
- Spanish <http://www.cgna.gov.br/carsam/Espanhol/index.htm>
- Portuguese <http://www.cgna.gov.br/carsam/Portugues/index.htm>

4.21 The States, Territories, and International Organizations are requested to disseminate the form as widely as possible; IATA and IFALPA are requested to aid in the distribution of the form to pilots for their reporting use. The recommended use of this form will be in effect 22 November 2005.

4.22 The meeting reviewed the list of LHDs submitted by CARSAMMA.

4.23 The meeting discussed the application of risk and duration value to coordination errors in situations where the aircraft was not in conflict with another aircraft. Due to incomplete reports, the Group did not come to a conclusion and in the interim those reports will remain in the database for further study and CARSAMMA will send an inquiry to the reporting States, Territories, and International Organizations requesting further details for each of the LHD events that fall under this category.

4.24 The meeting recalled that this is the second consecutive meeting of the Scrutiny Group the vast majority of the LHDs reported are caused by errors due ACT-unit-to-ACT-unit transition message – Code M. The meeting agreed to urge all States, Territories and International Organizations to apply conclusion AP/ATM/9/4 which contains the Error Prevention Programme in the Communications between adjacent ACCs. (See **Appendix B** to this part of the report).

4.25 The proposed remedial action of reporting 10 minutes prior to a boundary crossing that was not approved by the plenary at AP/ATM/10, was discussed.

4.26 The meeting determined that most code M errors are related to Oceanic airspaces and agreed to resubmit the previous recommendation of requiring an aircraft in oceanic operations to report to the next air traffic service unit 10 minutes prior to entering the succeeding FIR.

4.27 The meeting thoroughly discussed this proposal and recalled that many of the letters of agreement include within their communication transference procedures from one ACC to another, 5 and/or 10 minutes before the aircraft over-flies the transference point in the boundary of the FIRs. This procedure maintains the responsibility in the transferring unit until the aircraft reaches the transference point agreed.

4.28 It was agreed that those States and International Organizations that have the above-mentioned regulation in their Operational Letters of Agreement, apply the procedure and carry out a supervision of its application.

4.29 On the other hand, States/Territories and International Organizations that do not have the above-mentioned regulation should examine the feasibility to implement it in the oceanic airspaces without radar coverage.

4.30 Finally, the meeting agreed on the need that IFALPA, through their internal mechanisms, inform the pilots on this regulation.

New data collection

4.31 CARSAMMA requests that all States, Territories and International Organizations submit two weeks worth of traffic samples in the same format as previous reports by January 2006 in order to complete the required one year post RVSM implementation safety analysis. See **Appendix C** to this part of the report. In this respect, the meeting formulated the following conclusion:

Conclusion AP/ATM/11/6 - Data collection

That CAR/SAM States and International Organizations:

- a) carry out a new 15-days data collection from 1 to 15 December 2005 and the data be sent to CARSAMMA no later than 30 January 2006, to permit a post-RVSM implementation safety assessment to be submitted to the AP/ATM/12 meeting; and
- b) use the format shown in Appendix C to this part of the report.

APPENDIX A

CARSAMMA

Caribbean and South American Monitoring Agency

The information contained in this form is confidential and will be used for statistical safety analysis purposes only.

ALTITUDE DEVIATION FORM

Report to the CARSAMMA of an altitude deviation of 300ft or more, including those due to TCAS, Turbulence and Contingency Events

1. Today's date:		2. Reporting Unit:	
DEVIATION DETAILS			
3. Operator Name:	4. Call Sign:	5. Aircraft Type:	6. Mode C Displayed:
7. Date of Occurrence:	8. Time UTC:	9. Occurrence Position (lat/long or Fix):	
10. Cleared Route of Flight:			
11. Cleared Flight Level:	12. Estimated Duration at Incorrect Flight Level (seconds):	13. Observed Deviation (+/- ft):	
14. Other Traffic Involved:			
15. Cause of Deviation (<i>brief title</i>): (Examples: ATC Loop Error, Turbulence, Weather, Equipment Failure)			
AFTER DEVIATION IS RESTORED			
16. Observed/Reported Final Flight Level*: *Please indicate the source of information – ModeC/Pilot	Mark the appropriate box 17. Is the FL above the cleared level: <input type="checkbox"/> 18. Is the FL below the cleared level: <input type="checkbox"/>	19. Did this FL comply with the ICAO Annex 2 Tables of Cruising Levels? <input type="checkbox"/> Yes <input type="checkbox"/> No	

NARRATIVE

20. Detailed Description of Deviation

*(Please give your assessment of the actual track flown by the aircraft and the cause of the deviation.)***CREW COMMENTS (IF ANY)**

When complete please forward the report(s) to:

Management Center Of Air Navigation Caribbean and South American Monitoring Agency (CARSAMMA)
 Av. Brig. Faria Lima, 1941
 São José dos Campos, SP
 Cep: 12227-000 Brazil
 Telephone: (55-12) 3904-5004 or 3904-5010
 Fax: (55-12) 3941-7055
 E-Mail: carsamma@cna.gov.br

APPENDIX B
DESCRIPTION OF CRITERIA

Note: *The following terms, expressions and definitions have not been approved by ICAO Council and they should only be used for the analysis of Large Height Deviations.*

Cleared Flight Level – the flight level at which the pilot was cleared or currently operating (eg, Aircrew accepts a clearance intended for another aircraft and ATC fails to capture the read back error or aircrew conforms to a flawed clearance delivered by ATC)

Reference Flight Level – The altitude that would have provided at least the minimum separation (vertical or horizontal) required

That flight level from which the Height Deviation is calculated; this level may be different from the Cleared Flight Level and must often be determined by the Scrutiny Group operational experts from the data in the Large Height Deviation report

Event Flight Level – the flight level of error, the incorrect altitude of operation for an identifiable period of time without having received an ATC clearance

Height Deviation – any altitude variation of 300ft or greater from the assigned altitude, these variations can be the result of turbulence, equipment malfunction, ATC loop errors, etc.

ATC Loop Errors – any incident where there is a misunderstanding between the pilot and the controller, failure to properly coordinate altitude information or unable to maintain situational awareness

Total Deviation – the total amount of feet between the altitudes of current operation prior to the deviation and the point at which the aircraft is once again under ATC supervision, a deviation that resulted in an increase of altitude will be recorded as a positive number, a deviation that resulted in a decrease of altitude will be recorded as a negative number

Hazard Zone – 300ft buffer zone above and below each flight level (Diagram 1-A)

Duration - length of time that an aircraft was level at an altitude that was not cleared by air traffic control, duration will be recorded in one second increments (Diagram 1-A).

Levels Crossed – the total number of flight levels between the point that the aircraft exits the cleared flight level and is once again under ATC supervision

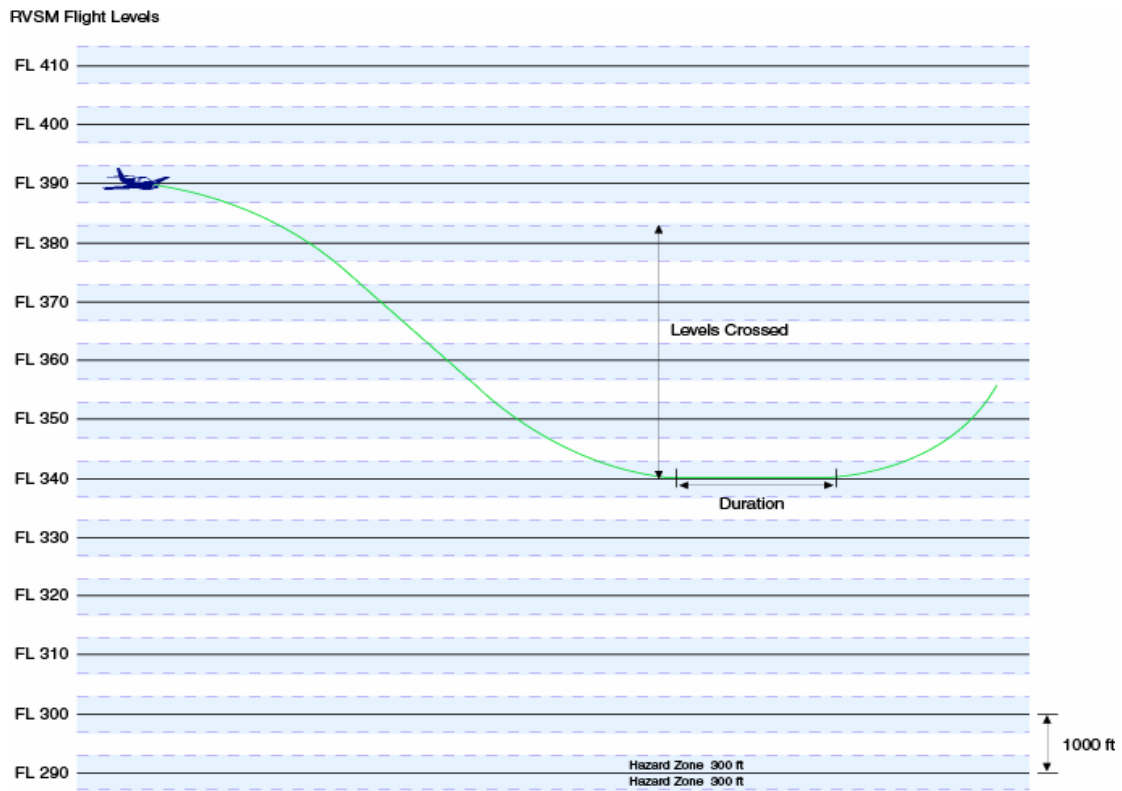
1) Levels Final – the cleared flight level after the error/deviation

Code – a category and a subcategory assigned to each event (Diagram 1-B)

Drift	1000 ft per minute	Minimum	TBD
Normal	1500+ ft per minute	Normal	TBD
Rapid	2500+ ft per minute	Expedite	TBD

Codes for Vertical Errors

A	Failure to climb/descend as cleared
B	Climb/descend without ATC clearance
C	Entry into airspace at an incorrect flight level
D	Deviation due to turbulence or other weather related cause
E	Deviation due to equipment failure
F	Deviation due to collision avoidance system (TCAS) advisory
G	Deviation due to contingency event
H	Aircraft not approved for operation in RVSM restricted airspace
I	ATC system loop error; (e.g. pilot misunderstands clearance message or ATC issues incorrect clearance)
J	Equipment control error encompassing incorrect operation of fully
K	Incorrect transcription of ATC clearance or re-clearance into the FMS
L	Wrong information faithfully transcribed into the FMS (e.g. flight plan followed rather than ATC clearance or original clearance followed instead of re-clearance)
M	Error in ATC-unit-to-ATC-unit transition message
N	Negative transfer received from transitioning ATC-unit
O	Other
P	Unknown



APPENDIX C

TRAFFIC FLOW EVALUATION FORM							
FIR IDENTIFICATION							
DATE	ACFT ID	OWNER/ OPERATOR	ACFT TYPE	ORIGIN	DESTINATION	ROUTE	FL

- Use the EXCEL to provide the data above.
- If the aircraft change the route or FL during its flight inside the FIR, inform all the routes/flight levels used separated by “/”. Ex: UA314/UL302/UL765..., 320/340/320...
- Use in the field “DATE” the following format: “dd/mm/yy”
- Use ICAO codes in the other fields.

Agenda Item 5: Other matters**Harmonization of the ATS contingency plans of Argentina, Bolivia, Brazil and Paraguay**

5.1 Upon analyzing this subject, the meeting deemed it advisable to establish an Ad-hoc Group composed by Argentina, Bolivia, Brazil and Paraguay; to harmonize their respective contingency plans, define the means and tools for the exchange and dissemination of information and include them in the operational letters of agreement, in order to guarantee the availability of a trunk route network serving the main traffic flows of the region, so as to ensure uninterrupted aircraft traffic in the FIRs involved.

5.2 The Ad-Hoc Group concluded that each of the aforementioned States had committed itself to adjust its corresponding national contingency plan according to the harmonized plan, exchanging the information necessary to establish standard measures to be applied in case of contingency in more than one adjacent FIR.

5.3 They also agreed to prepare and disseminate a single NOTAM model for the activation of the Plan, when necessary, in accordance with the AP/ATM/8 Report.

5.4 Consideration was also given to including in **Appendix A** essential information on the course of action to be taken by the respective ATS bodies.

5.5 In view of the above, the meeting approved the following Conclusion:

Conclusion AP/ATM/11/7 - Harmonization of the ATS contingency plans of Argentina, Bolivia, Brazil and Paraguay

That Argentina, Bolivia, Brazil and Paraguay civil aviation administrations:

- a) exchange the information necessary to harmonize national contingency plans, so that they can be included as appendices to the operational letters of agreement and signed at the next AP/ATM/12 meeting; and
- b) complete the exchange of information on the ATC operational procedures to be applied in case of contingency.

Implementation, extension, realignment, partial/total elimination and change of direction of RNAV and conventional routes

5.6 The meeting examined the new RNAV routes proposed by Argentina, Bolivia, Brazil, Chile and Peru, in order to make some modifications to the RNAV route network and reduce some paths, leading to a compatible transition between the en-route flight phase and the terminal control area (TMA). To deal with this subject, Ad-hoc groups, made up by the delegations of the FIRs involved, were established to study the feasibility of their implementation, and the following was agreed:

Conclusion AP/ATM/11/8**Implementation, extension, realignment, partial/total elimination and change of direction of RNAV and conventional routes**

That the Secretariat, as soon as it receives the results of the coordination efforts made and the coordinates of the reporting points from the States involved, start a CAR/SAM Air Navigation Plan (ANP) - Basic amendment process, in accordance with the indications contained in **Appendices B and C** to this part of the report, whose effective date will be two AIRAC periods following the approval of the amendment by the ICAO Council.

APPENDIX A**HARMONIZED INTERNATIONAL CONTINGENCY PLANS**

HEADING	AIRWAYS	FLIGHT LEVELS	REMARKS
N / S	UM 402 / UA556	340	FIR AMAZONICA / LAPAZ / ASU / SIS / EZE
S / N	UW 8/UW 20/UL 793	320	EZE / SIS / ASU / LAPAZ / AMAZONICA
S / N	UW 8/UW 20/UR 554	310	EZE / SIS / ASU
N / S	UL 417	390	FIR AMAZONICA / LAPAZ / CBA
S / N	UA 558 / UA 559	360	EZE / CBA / LAPAZ / AMAZONICA
N / S	UB 688/ UW 64/ UW 65	360	FOZ / ASU / SIS / EZE
S / N	UL 324	290	EZE/ CUARA/ ELAMO/ FOZ
E / W	UA 307	360	FOZ / ASU/ BOBIK/ SIS/ CBA/ DOZ/ SCEL
W / E	UM 529/ UR 554/ UM 544	310*	SCEL/ DOZ/ CBA/ SIS/ ASU/ AKSUL/ SBCW
E / W	UM 415	300	FIR SBCW / FIR LAPAZ
W / E	UM 415	330	FIR LAPAZ / FIR CURITIBA
* =FL TO BE CONFIRMED WITH BRAZILIAN CIVIL AVIATION ADMINISTRATION			
N= NORTH		S= SOUTH	
E= EAST		W= WEST	
LONGITUDINAL SEPARATION BETWEEN AIRCRAFT WILL BE 15 MIN, IRRESPECTIVE OF VERTICAL SEPARATION			
AUTOTRANSFER OF CONTROL SHOULD BE TAKEN INTO ACCOUNT			

APPENDIX B

IMPLEMENTATION, EXTENSION, REALIGNMENT, PARTIAL AND TOTAL ELIMINATION OF RNAV AND CONVENTIONAL ROUTES PROPOSED BY BRAZIL

X1 - Implementation of route VOR FOZ/SIDAK/USBIM/VOR PVH.

ROUTE UMXX1 – STATES INVOLVED: BOLIVIA, BRAZIL and PARAGUAY

Bolivia, Brazil and Paraguay will coordinate, as necessary for the implementation of route RNAV VOR FOZ/SIDAK/USBIM/VOR PVH, and will present to the ICAO SAM Office the coordinates of the reporting points, as per Table 1, as soon as they have been established.

TABLE 1

ROUTE UMXX1 – VOR POR/VOR FOZ/VOR PVH		
REPORTING POINT	COORDINATES	REMARKS
VOR FOZ	S25°35.00'/W054°30.21'	VOR FOZ DEL IGUAZU
XXXX1	Sxx°xx.xx'/W0xx°xx.xx'	CROSSING WITH ROUTE UL301
XXXX2	Sxx°xx.xx'/W0xx°xx.xx'	CROSSING WITH ROUTE UB565
XXXX3	Sxx°xx.xx'/W0xx°xx.xx'	CROSSING WITH ROUTE UM554
XXXX4	Sxx°xx.xx'/W0xx°xx.xx'	LIM FIR SGFA/SBCW
XXXX5	Sxx°xx.xx'/W0xx°xx.xx'	CROSSING WITH ROUTE UM799
SIDAK	S19°38.35'/W058°12.47'	BOUNDARY FIR SBCW/SLLF
XXXX6	Sxx°xx.xx'/W0xx°xx.xx'	CROSSING WITH ROUTE UB652
XXXX7	Sxx°xx.xx'/W0xx°xx.xx'	CROSSING WITH ROUTE UL540
XXXX8	Sxx°xx.xx'/W0xx°xx.xx'	LIM FIR SLLF/SBAZ
UBSIM	S12°56.50'/W061°50.62'	LIM SECTOR FIR SBAZ
XXXX9	Sxx°xx.xx'/W0xx°xx.xx'	CROSSING WITH ROUTE UA316
XXXX10	Sxx°xx.xx'/W0xx°xx.xx'	CROSSING WITH ROUTE UL793
VOR PVH	S08°42.84'/W063°54.20'	VOR PORTO VELHO

X2 – Implementation of RNAV Routes UMXX2 (VOR FRM/POLAN/VUMPI/VOR PAY/VOR BNS); Route RNAV UMXX3 (VOR TUY/VOR VAGAN/TAROP/VOR PSN); and RNAV Route UMXX4 (VOR GNA/PAKON/VOR BVI/TAROP/VOR PSN).

ROUTES UMXX2, UMXX3, AND UMXX4 – STATES INVOLVED: BRAZIL and VENEZUELA

Brazil and Venezuela will coordinate as necessary for the implementation of RNAV routes VOR FRM/POLAN/VUMPI/VOR PAY/VOR BNS; RNAV VOR TUY/VOR VAGAN/TAROP/VOR PSN; and RNAV VOR GNA/PAKON/VOR BVI/TAROP/VOR PSN, and will present to the ICAO SAM Office the coordinates of the reporting points as per Tables 2, 3 and 4, as soon as they have been established.

TABLE 2

ROUTE UMXX2 – RNAV VOR FRM/POLAN/VUMPI/VOR PAY/VOR BNS			
REPORTING POINTS	COORDINATES	FLIGHT DIRECTION	REMARKS
VOR FRM	S15°33.46'/W047°20.82'	ONE-WAY VOR FRM VUMPI	VOR FORMOSA
POLAN	S11°49.69'/W050°53.16'		CROSSING WITH ROUTE UM799
XXXX1	Sxx°xx.xx'/W0xx°xx.xx'		LIM FIR SBBS/SBAZ
VUMPI	N01°59.40'/W063°56.90'	TWO-WAYS VUMPI/VOR BNS ↓↑	LIM FIR SBAZ/SVZM
VOR PAY	N05°37.20'/W067°36.50'		VOR PUERTO AYACUCHO
VOR BNS	N08°36.90'/W070°13.10'		VOR BARINAS

TABLE 3

ROUTE UMXX2 – RNAV VOR TUY/VOR VAGAN/TAROP/VOR PSN			
REPORTING POINTS	COORDINATES	FLIGHT DIRECTION	REMARKS
VOR TUY	N10°17.70'/W066°47.80'	TWO WAYS VOR TUY/VAGAN ↓↑	VOR TUY
VAGAN	N03°49.15'/W063°05.03'		LIM FIR SVZM/SBAZ
TAROP	S09°01.92'/W054°37.96'	ONE WAY VOR VAGAN/VOR PSN ↓	RD 063 VOR CXB
XXXX1	Sxx°xx.xx'/W0xx°xx.xx'		LIM FIR SBAZ/SBBS
VOR PSN	S21°59.10'/W047°20.60'		VOR PIRASSUNUNGA

TABLE 4

ROUTE UMXX2 – RNAV VOR GNA/PAKON/VOR BVI/TAROP/VOR PSN			
REPORTING POINTS	COORDINATES	FLIGHT DIRECTION	REMARKS
VOR GNA	N08°17.80'/W062°45.10'	TWO WAYS VOR GNA/VOR BVI ↓↑	VOR GUAYANA
PAKON	N04°28.90'/W061°18.10'		LIM FIR SVZM/SBAZ
VOR BVI	N02°51.13'/W060°41.21'		VOR BOA VISTA
TAROP	S09°01.92'/W054°37.96'	ONE WAY VOR BVI/VOR PSN ↓	RD 063 VOR CXB
XXXX1	Sxx°xx.xx'/W0xx°xx.xx'		LIM FIR SBAZ/SBBS
VOR PSN	S21°59.10'/W047°20.60'		VOR PIRASSUNUNGA

X3 – Implementation of RNAV route UMXX4 (VOR SCB/NDB BRU/ANGOL/DEMIT/MONIK/VOR BNS).

ROUTE UMXX4 – STATES INVOLVED: BRAZIL, COLOMBIA and VENEZUELA.

Brazil, Colombia and Venezuela will coordinate as necessary to implement RNAV route VOR SCB/NDB BRU/ANGOL/DEMIT/MONIK/VOR BNS, and will present to the ICAO SAM Office the coordinates of the reporting points as per Table 5, as soon as they have been established.

TABLE 5

ROUTE UMXX4 – RNAV VOR SCB/NDB BRU/ANGOL/DEMIT/MONIK/VOR BNS			
REPORTING POINTS	COORDINATES	FLIGHT DIRECTION	REMARKS
VOR SCB	S23°30.40'/W047°22.70'	ONE WAY VOR SCB/DEMIT ↓	VOR SOROCABA
NDB BRU	S22°18.80'/W049°06.40'		NDB BAURU
XXXX1	Sxx°xx.xx'/W0xx°xx.xx'		LIM FIR SBCW/SBBS
ANGOL	S15°49.41'/W054°01.06'		CROSSING WITH ROUTE UM799
XXXX2	Sxx°xx.xx'/W0xx°xx.xx'		LIM FIR SBBS/SBAZ
DEMIT	S07°14.18'/W059°39.44'		CRUCE CON UA317 y UM402
MONIC	S01°44.07'/W063°14.05'	TWO WAYS VUMPI/VOR BNS ↓ ↑	CROSSING WITH UA323
XXXX3	Nxx°xx.xx'/W0xx°xx.xx'		LIM FIR SBAZ/SVZM
XXXX4	Nxx°xx.xx'/W0xx°xx.xx'		LIM FIR SVZM/SKED
XXXX5	Nxx°xx.xx'/W0xx°xx.xx'		LIM FIR SKED/SVZM
VOR BNS	N08°36.90'/W070°13.10'		VOR BARINAS

X4 – Realignment of route UR640**ROUTE UR640 – STATES INVOLVED: BRAZIL and VENEZUELA**

Brazil and Venezuela will carry out realignment of route UR640 according to the new path defined in Table 6 and shall present to the ICAO SAM Office the coordinates and reporting points as per Table 5, as soon as they are established

TABLE 6

UR640 CURRENT	UR640 NEW PATH			
VOR MAN	REPORTING POINT	COORDINATES	FLIGHT DIRECTION	REMARKS
TANGO	VOR MAN	S03°02.20'/W060°07.50'	TWO WAYS VOR MAN/PAY ↑ ↓	VOR MAN
BLUSH	VUMPI	N01°59.40'/W063°56.90'		LIM FIR SBAZ/SVZM
NEBIL	XXXX1	Sxx°xx.xx'/W0xx°xx.xx'		CROSSING WITH ROUTE UL793
AKTAK	VOR PAY	N05°37.20'/W067°36.50'		VOR PUERTO AYACUCHO
VOR PAY				

X5 – Realignment of route UM548**ROUTE UM548 – STATES INVOLVED: BRAZIL and PARAGUAY**

Brazil and Paraguay shall carry out the realignment of UM548 as per the new path as defined in Table 7 and shall present to the ICAO SAM Office the coordinates of the reporting points, as soon as they are established.

TABLE 7

UM548 CURRENT	UM548 NEW PATH			
VOR VAS	REPORTING POINTS	COORDINATES	FLIGHT DIRECTION	REMARKS
GAXAS	VOR VAS	S25°14.65'/W057°31.31 ,	TWO WAYS VOR VAS/CTB	VOR ASUNCIÓN
ARISE	VOR FOZ	S25°35.00'/W054°30.21 ,		VOR FOZ DEL IGUAZU
CRANE	ILBEK	S25°40.59'/W051°27.47 ,		CROSSING WITH UM654
SALON	VOR CTB	S25°31.92'/W049°10.06 ,		VOR CURITIBA
PIPAL				
VERBO				
VOR CTB				

X6 – Realignment of routes UL201 y UL304**ROUTES UL201/ UL304 – STATE INVOLVED: BRAZIL**

Brazil should carry out the realignment of route UL201 and UL304 according to the new path defined in Tables 8 and 9 and shall present to the ICAO SAM Office the coordinates of the reporting point as soon as they are established.

TABLE 8

ORIGINAL SEGMENT	NEW SEGMENT			
	REPORTING POINTS	COORDINATES	FLIGHT DIRECTION	REMARKS
---VOR MTU/CLOTI/ DEMUR/ NAFTA/ EGLER---	VOR MTU	N01°14.50'/W070°14.20'	ONE WAY VOR MTU/PSN	VOR MTU
	CLOTI	S02°07.40'/W067°10.10'		CROSSING UL309
	BUMBA	S03°33.10'/W065°43.20'		CROSSING UA566
	EGLER	S05°18.30'/W064°15.30'		CROSSING UL306
	-----	-----		-----
	VOR PSN	S21°59.10'/W047°20.60'		VOR PIRASSUNUNG A

TABLE 9

CURRENT SEGMENT	NEW SEGMENT			
	REPORTING POINTS	COORDINATES	FLIGHT DIRECTION	REMARKS
--- /ISANI/VOR BVI/TESAL/ VOR BRS---	VOR BCO	S23°24.40'/W046°23.10'	ONE WAY VOR BCO/VOR BVI	VOR BONSSUCESO
	NDB PCL	S21°50.10'/W046°33.90'		NDB POCOS DE CALDAS
	VOR GOI	S16°37.95'/W049°12.92'		VOR GOIANIA
	TERES	S12°28.54'/W051°22.09'		CROSSING WITH UM799
	XXXX1	Sxx°xx.xx'/W0xx°xx.xx'		LIM FIR SBBS/SBAZ
	DARLO	S05°12.53'/W055°22.12'		LIMITE SECTOR SBAZ
	-----	-----	-----	
	VOR BVI	N02°51.13'/W060°41.21'	TWO WAY BVI VOR/ ISANI	VOR BOA VISTA
	ISANI	N04°14.98'/W061°35.53'		LIMA FIR SBAZ/SVZM
	-----	-----		CONTINUATION

X7 – Change in direction of route UL795**ROUTE UL795 – STATE INVOLVED: BRAZIL**

Brazil should carry out changes in route UL795 as defined in Table 10 and present to the ICAO SAM Office the coordinates of reporting points, as soon as they are established.

TABLE 10

ORIGINAL SEGMENT	UL795 CHANGES			
	REPORTING POINTS	COORDINATES	FLIGHT DIRECTION	REMARKS
---/VUMPI/ ---/VOR PSN	KEEP THE CURRENT SEGMENT, BUT CHANGE TO ONE WAY FROM VUMPI TO PSN VOR			

X8 – Realignment and partial elimination of route UA315**ROUTE UA315 – STATES: BRAZIL and VENEZUELA**

Brazil and Venezuela should carry out realignment and partial elimination of route UA315 as per the new segment defined in Table 11 and present to the ICAO SAM Office the coordinates of reporting points as soon as they have been established.

TABLE 11

CURRENT SEGMENT	UA315 NEW SEGMENT		FLIGHT DIRECTION	SEGMENT TO DELETE
	REPORTING POINTS	COORDINATES		
---/KAMUT/ VAGAN/ VOR MAN/ VOR JAC/ VOR ATF---	VOR TUY	N10°17.70'/W066°47.80'	TWO WAYS VOR TUY/VOR MAN	VOR MAN/VOR JAC/VOR ATF
	VAGAN	N03°49.15'/W063°05.03'		
	VOR MAN	S03°02.20'/W060°07.50'		

X9 – Partial elimination of route UB695**ROUTE UB695 – ESTADO INVOLUCRADO: BRASIL**

Brazil should carry out the partial elimination of route UB695 according to the new path defined in Table 12 and present to the ICAO SAM Office the coordinates of reporting points, as soon as they have been established.

TABLE 12

UB695		
CURRENT SEGMENT	SEGMENT TO BE ELIMINATED	RESULTING SEGMENT
VOR BRS/ VOR URP/ CALAD/ VOR VAS	VOR BRS/VOR URP	VOR URP/CALAD/VOR VAS

X10 – Extension of route UL322**ROUTE RNAV UL322 – STATES INVOLVED: BOLIVIA, BRAZIL and GUYANA**

Bolivia, Brazil and Guyana carry out the necessary coordination for the extension of route RNAV UL322, according to the segment defined in Table 13 and present to the ICAO SAM Office the coordinates of the reporting points as soon as they have been established.

TABLE 13
ROUTE UL322

REPORTING POINT	COORDINATES	FLIGHT DIRECTION	REMARKS
VOR VIR	S17°37.5'/W063°08.90'	TWO WAYS VOR VIR/VOR TIM ↓↑	VOR VIRU VIRU
ILRES	S13°09.40'/W062°21.20'		LIM FIR SLLF/SBAZ
VOR MAN	S03°02.20'/W060°07.50'		VOR MAN
XXXX1	Nxx°xx.xx'/W0xx°xx.xx'		LIM FIR SBAZ/SYGC
VOR TIM	N06°30.80'/W058°14.90'		VOR TIMEHRI

X11 – Total Elimination of route UB680**ROUTE UB680 – STATES INVOLVED: BRAZIL, FRENCH GUYANA AND SURINAME**

Brazil, French Guyana, Suriname and IATA carry out the studies with the aim to verify the feasibility of the total elimination of route UB680 and present to the ICAO SAM Office the results, as soon as they have been reached.

APPENDIX C**IMPLEMENTATION, REALIGNMENT AND PARTIAL/TOTAL ELIMINATION OF RNAV AND CONVENTIONAL ROUTES PROPOSED BY ARGENTINA, BOLIVIA, CHILE AND PERU****ROUTE UA-568**

Bolivia and Chile agree that route UA 568, between Arica (Antofagasta FIR) and La Paz (La Paz FIR), be changed to an RNAV route in the upper airspace between these cities with effective AIRAC date 16 March 2006. The route designator will be coordinated with the Secretariat.

ROUTE UB-679

Argentina, Bolivia and Peru, upon analyzing the implications of intersection EKAMO with Chile, and the scarce traffic over-flying this ATS route, agree to eliminate the following segment: VOR/DME/JUJUY (Cordoba FIR) – NDB CHARAÑA (La Paz FIR) – VOR/DME AREQUIPA (Lima FIR).
Effective AIRAC date 16 March 2006.

ROUTE UA-316

Argentina, Bolivia and Brazil, upon analyzing the routes of their respective FIRs and taking into account that they already have RNAV routes on that same path, agree to eliminate the following segment:
-VOR/DME SALTA (FIR Córdoba) - VOR/DME JUJUY (Cordoba FIR)-VOR/DME TARIJA (FIR La Paz) – VOR/DME VIRU VIRU (La Paz FIR).

-Effective AIRAC date 16 March 2006, and for the segment VOR/DME VIR/VOR/DME MAN (La Paz FIR and Amazonica FIR), the effective date will be the same as that established for the extension of route UL322 from the Viru Viru VOR to the Timehri VOR.