

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

Second Meeting/Workshop of ATM Authorities and Planners
(Lima, Peru, 14-18 May, 2001)

Item 2: **Definitive implementation of RNAV routes UT 780, UT 795, and UT 799 and analysis of new pre-operational trials and demonstrations on those routes**

(presented by the Secretariat)

Summary

This working paper presents aspects connected with RNP and RVSM and analyses the possibility of conducting pre-operational RNP and/or RVSM trials and demonstrations on the UT 780, UT 795, and UT 799 RNAV trial and demonstration routes.

References:

- Report of the CAR/SAM/3 RAN Meeting
- CAR/SAM ANP - FASID
- UNDP/ICAO Project RLA/98/003 Project "Transition to the CNS/ATM Systems in the CAR/SAM Regions"
- Doc. 9574, Manual on the Implementation of Vertical Separation Minima of 1000 feet between FL 290 and FL 410, inclusive
- Doc. 9613, Required Navigation Performance (RNP) Manual
- Doc. 9689, Manual on Airspace Planning Methodology for determining Separation Minima
- Doc. 4444 - PANS-RAC
- GREPECAS 7 and 8 Reports
- Reports of CNS/ATM/IC Subgroup Meetings 2, 3 and 4

1. Introduction

1.1 Pursuant to the planning done by the CAR/SAM Regional Planning and Implementation Group (GREPECAS) and endorsed by the Third CAR/SAM RAN Meeting, the decision was made to conduct a series of pre-operational trials and demonstrations on RNAV routes for long-haul flights between pairs of cities, which will make it possible to gradually introduce CNS/ATM elements in the CAR/SAM Regions.

1.2 In addition to this original aim, it was decided to include, in a later phase, trials and demonstrations of CNS elements and functions, as well as of other ATM elements, such as the assignment of RNP and RVSM values.

2. Analysis

2.1 The Meeting/Workshop of Air Traffic Management (ATM) Authorities and Planners, held in Lima, Peru from 18 to 21 June, 2000, adopted the use of a longitudinal separation minimum of 10 minutes, backed by the Mach number technique (MNT), and/or 80 NM between aircraft at the same flight level, which was originally identified by the GREPECAS CNS/ATM/IC Subgroup as one of the minimum requirements for RNAV trial and demonstration routes.

2.2 On the other hand, and according to information supplied by the States and the analyses of traffic flows being conducted in the CAR/SAM Regions by the UNDP/ICAO Project RLA/98/003 "Transition to the CNS/ATM Systems in the CAR/SAM Regions", there is no traffic congestion in general in the region.

2.3 There are, however, some airspace sectors that are already experiencing traffic congestion, particularly during "peak" periods and hours. As a result, a significant number of aircraft are not operating at their optimum flight levels, thus impairing the efficiency of air operations. This situation can be attributed mainly to the lack of uniformity in the application of longitudinal separation minima in the FIRs involved.

2.4 The Third CAR/SAM RAN Meeting recognised that, in an ATS route structure, uniform application of the smallest possible longitudinal separation minima available in several flight information regions (FIRs) would contribute to more effective use of that airspace.

2.5 In this connection, some ACCs in the CAR/SAM Regions are already applying 10-minute MNT and 80 RNAV longitudinal separation minima. However, according to information supplied by the States and the analyses made by Project RLA/98/003, the foreseen increase in air traffic would increase the percentage of aircraft that do not operate at their optimum flight levels and these longitudinal separation minima would be insufficient to expand airspace capacity and availability of optimum flight levels to cope with the demand in the CAR/SAM Regions. In order to achieve this necessary increase in airspace capacity, the application of reduced separations using RNP and RVSM has been foreseen.

Need for implementing RNP

2.6 In developing the RNP concept, ICAO recognized that existing aircraft navigation systems are capable of attaining a predictable level of navigation performance precision and that more effective use of available airspace is possible by drawing on that navigation capacity.

2.7 In addition to the improvements that could be obtained by applying the RNAV technique to reduce longitudinal separation in distance units to 80 NM between aircraft with RNAV equipment,

further reductions of up to 50 NM could be achieved in lateral and longitudinal separation minima in the airspace and on routes in the CAR/SAM Regions that are designated as RNAV and RNP 10, in keeping with Annex 11, attachment B and with the PANS-RAC, Doc. 4444, Part III, 8.6.

2.8 The safe introduction of lateral separation minima of 50 NM and, subsequently, of longitudinal separation minima of 50 NM, requires the establishment of safety management measures. These include, among other actions, an assessment of airspace safety before implementation, and the establishment of an airspace surveillance programme to guarantee maintenance of the required safety level.

Need for Implementing RVSM

2.9 In operational terms, even if no air traffic congestion problems existed, implementation of reduced vertical separation minima (RVSM) of 1000 ft between FL290 and FL 410 is, undoubtedly, the best way of increasing the availability of optimum flight levels.

2.10 Experience in RVSM application on ATS routes in the North Atlantic and recently in Asia Pacific has clearly shown the advantages it offers. Its application in the CAR/SAM Regions would permit better use of airspace, increasing its capacity without jeopardizing the safety of air operations, thereby benefiting air transportation economics.

2.11 RVSM implementation in the CAR/SAM Regions, as in the case of the application of reduced lateral and longitudinal separations, will require a formal risk assessment and the establishment of operational safety management procedures.

RNP and RVSM trials and demonstrations

2.12 Given the very nature of the operations to be carried out on RNAV trial and demonstration routes, it was clear at the First Meeting/Workshop of ATM Authorities and Planners that the main requirement for operating on those routes was for aircraft to be equipped with RNAV navigation equipment.

2.13 Therefore, when developing a programme of pre-operational trials and demonstrations for RNP implementation, it should be kept in mind that the required RNAV equipment should be endowed with at least the functions and features (or their equivalent) applicable to the RNP type to be implemented. This will require approval of the RNAV equipment by the States involved. Doc. 9613, Required Navigation Performance (RNP) Manual, specifies the operational and functional requirements for using RNAV equipment in an RNP environment.

2.14 Moreover, for implementing RVSM, aircraft should also have equipment that meets the requirements for operating in such airspace. Doc. 9574, Manual on the Implementation of Vertical Separation Minima of 1000 feet between FL 290 and FL 410 inclusive, gives a detailed account of the requirements applicable to all aircraft wishing to operate in RVSM airspace.

2.15 It should be kept in mind that, in the present ATS Route Network of the CAR/SAM Regions, the airspace is shared by conventional and RNAV routes, among them the RNAV trial and demonstration routes, whose operating procedures are different. However, due to the proximity between the two, the ACCs involved are forced to apply the same ATS procedures, particularly those concerning longitudinal separation minima, for aircraft equipped with RNAV and those carrying conventional navigation equipment.

2.16 In light of the foregoing, an analysis should be made of the impact on airspace before implementing reduced separation minima based on RNP 10, particularly with respect to those areas where simultaneous use is permitted of aircraft equipped with RNAV and aircraft that are not RNAV-equipped and/or that do not meet the requirements for flying RNP 10.

2.17 Therefore, considering the many parameters that must be analysed for implementation of CNS/ATM systems, it is advisable during that process to gradually introduce the necessary elements for an evolutionary transition, as operational experience is gained and operational and economic benefits are obtained, while maintaining or improving the required safety levels.

2.18 In this sense, the RNAV pre-operational trial and demonstration routes would be an appropriate scenario for early and harmonious introduction of RNP and RVSM in the CAR/SAM Regions. Doc. 9689, Manual on Airspace Planning Methodology for determining Separation Minima, gives ample details on related aspects for the implementation process.

2.19 Nevertheless, in order to reach a decision on the implementation of a pre-operational RNP and/or RVSM trial and demonstration programme, the Meeting should also consider aspects related to the costs involved in such programme as well as the benefits expected as a result of such implementation.

2.20 If we take as an example the implementation of RVSM trials and demonstrations on any of the RNAV routes we are concerned with, it can be noted that there are costs that should be financed by the administrations involved. While the aspects described below are not exhaustive, they do give an idea of some of the costs to be considered:

- a. study of the impact that such separation minima would have on the airspace
- b. study of the impact on air traffic services, including amendments to CAR/SAM Regional Supplementary Procedures
- c. training of ATC personnel
- d. establishment of an RVSM aircraft certification programme
- e. airspace safety assessment to comply with the desired safety level of 5×10^{-9}

- f. cost-benefit analysis
- g. establishment of an oversight agency at the regional level
- h. participation of the administrations in follow-up and implementation meetings, etc.

2.21 Users would also have additional costs that should be given due consideration, such as:

- a. study of the impact on aircraft fleet
- b. airborne equipment to operate in the airspace in question
- c. approval of RVSM equipment
- d. crew training
- e. establishment of additional operating procedures, etc.

2.22 On the other hand, there would obviously be certain operational benefits if users make optimum use of flight levels, but these benefits would not be too significant, given the limited scope of the trials. The major benefit would be the acquisition of considerable experience by all the parties involved in the programme, especially because the aeronautical community is looking forward to a gradual implementation of RNP and RVSM in the CAR/SAM Regions.

2.23 As may be seen, Project RLA 98/003 is an extremely useful tool for carrying out these pre-operational trials and demonstrations, which would have to cover a period of at least two more years in order to achieve the desired objectives. Thus, a commitment would be needed from the administrations to finance the costs involved, and also from the users. We are speaking here of an earliest implementation date for any of these elements as the end of 2003.

2.24 For further reference of the meeting,, **Appendices A and B** to this working paper contain some of the requirements that must be met prior to the implementation of RNP 10 and RVSM on the pre-operational RNAV trial and demonstration routes in the CAR/SAM Regions. It should be added that the prerequisites for RVSM are the result of the work of the RVSM Task Force of the GREPECAS ATS Subgroup.

2.25 If the Meeting decides to conduct pre-operational RNP and/or RVSM trials and demonstrations on one or some of the RNAV routes based on the prerequisites set out in Appendices A and B, an implementation programme should be established, clearly indicating dates, responsible parties, and specific data for a successful implementation.

2.26 Inasmuch as this task is being performed by task forces of the ATM Committee (RNAV/RNP and RVSM Task Forces), the Meeting could consider channelling the development of an implementation programme through the ATM Committee of the ATM/CNS Subgroup and presenting the results of its work to GREPECAS and at the next Meeting/Workshop of ATM Authorities and Planners.

3. **Suggested action**

3.1 The Meeting is invited to take note of the information contained herein and to:

- a. exchange viewpoints on the advisability of starting RNP and/or RVSM pre-operational trials and demonstrations on one or all of RNAV routes UT 780, UT 795, and UT 799;
- b. review the prerequisites set out in Appendices A and B to this working paper; and
- b. if applicable, request the ATM Committee of the GREPECAS ATM/CNS Subgroup to prepare a timetable and programme for RNP and/or RVSM implementation on one or all of the RNAV routes deemed pertinent, with a view to their presentation to GREPECAS and at the Third Meeting/Workshop of ATM Authorities and Planners.

Appendix A

Prerequisites for RNP 10 implementation

1. Identification of the operational need
 - Traffic congestion during “peak” periods and hours;
 - Delays and increased flight time;
 - Non-direct routes and increase in the distance flown;
 - Fuel consumption;
 - Aircraft that do not operate at their optimum flight levels;
 - Lack of uniformity in longitudinal separation minima;
 - Longitudinal separation minima based on time instead of distance;
2. Impact on airspace
 - Simultaneous operation of aircraft with RNAV equipment and aircraft not RNAV-equipped and/or that do not meet the requirements , and application of the same ATS procedures, especially the longitudinal separation minima;
 - Need for better airspace sectorising;
 - Existence of airspaces for special use;
 - Need to make airspace more flexible;
 - WGS 84 implementation
3. Impact on Air Traffic Services
 - Normal and contingency ATS procedures;
 - Appropriate amendments to the CAR/SAM Regional Supplementary Procedures;
 - Training of ATC personnel;
 - Reduction of ATC workload;
 - Reduction in the number of incidents;
 - Increased safety of air operations
4. Impact on aircraft fleet
 - Aircraft with RNAV equipment that meets the requirements;
 - State approval of RNAV equipment
5. Impact on the crew
 - Normal and contingency operational procedures;
 - Crew training

6. Cost-benefit analysis

- Air traffic forecasts;
- Reduction of traffic congestion;
- Reduction of delays;
- Reduction of distance flown;
- Fuel and flight time savings;
- Financial feasibility

7. Impact on civil aviation administrations

- Implementation planning;
- Establishment of a method to assess airspace safety, considering the desired safety level of 5×10^{-9} established by the Third CAR/SAM RAN Meeting;
- Establishment of a Central Safety Oversight and Surveillance Agency during the pre-operational trial phase to ensure compliance with pre-determined safety criteria;
- Modification of the proposed system parameters after the trial phase, if necessary;
- Operational implementation;
- Maintenance of safety oversight and surveillance.

Appendix B

Prerequisites for RVSM implementation

1. Identification of the operational need
 - Traffic congestion during “peak” periods and hours;
 - Aircraft that do not operate at their optimum flight levels;
 - Fuel consumption
2. Impact on airspace
 - Simultaneous operation of aircraft with RNAV equipment and aircraft not RNAV-equipped and/or that do not meet the requirements , and application of the same ATS procedures, especially the longitudinal separation minima;
 - Availability of more optimum flight levels;
 - Need for better airspace sectorising;
 - Establishment of RVSM transition airspaces;
 - Sectorising of RVSM transition airspaces;
3. Impact on Air Traffic Services
 - Normal and contingency ATS procedures in RVSM airspace;
 - ATS procedures in RVSM transition airspace;
 - *Ad-hoc* procedures for ACAS contingencies;
 - Appropriate amendments to the CAR/SAM Regional Supplementary Procedures;
 - Training of ATC personnel;
 - ATC workload;
 - Reduction in the number of incidents;
 - Increased safety of air operations
4. Impact on aircraft fleet
 - Aircraft with RVSM equipment that meets the requirements;
 - Installation/streamlining of *ad-hoc* ACAS equipment for RVSM airspace;
 - State approval of RVSM equipment
5. Impact on the crew
 - Normal and contingency operational procedures;
 - Crew training;

- *Ad-hoc* training in the use of ACAS in RVSM airspace

6. Cost-benefit analysis

- Air traffic forecasts;
- Reduction of traffic congestion;
- Greater availability of optimum flight levels;
- Reduced delays;
- Fuel and flight time savings;
- Financial feasibility

7. Impact on civil aviation administrations

- Implementation planning;
- Establishment of a method for assessing airspace safety, considering the desired safety level of 5×10^{-9} established by the Third CAR/SAM RAN Meeting;
- Establishment of a Central Altitude Oversight and Surveillance Agency during the pre-operational trial phase to ensure compliance with pre-determined safety criteria;
- Modification of the proposed system parameters after the trial phase, if necessary;
- Operational implementation;
- Maintenance of altitude and safety oversight and surveillance