International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)

WORKING PAPER

GREPECAS/22 — WP/19
29/08/24

Fourth GREPECAS–RASG-PA Joint Meeting and
Twenty-second Meeting of the CAR/SAM Regional Planning and Implementation Group (GREPECAS/22)
Virtual Phase (Asynchronous, 16 September to 11 October 2024)
In-Person Phase (Lima, Peru, 20 to 22 November 2024)

Agenda Item 5: **CAR/SAM Air Navigation Services (ANS) Implementation**
5.1 Air Traffic Management (ATM), Airspace optimization, Air Traffic Flow Management (AFTM) and Search and Rescue (SAR)

STATUS OF AIRSPACE OPTIMIZATION PROGRAMME AND THE NEOSPACE-1 PROJECT

(Presented by the Secretariat)

EXECUTIVE SUMMARY

NOTE: This working paper will be updated, adopting the analysis and results of the NACC/WG/9 and SAMIG/32 meetings, referred to a CAR SAM harmonized framework for NEOSPACE-1 Project. The final discussion on this WP will be held during the last stage of Virtual phase of GREPECAS22, from 7 to 10 October 2024.

This Working Paper presents the most relevant results in the implementation of the Airspace Optimization Programme for the CAR and SAM Regions, as well as the coordination made between both regions under NEOSPACE-1 Project. A proposal for a common CAR/SAM Guide for implementation is presented. An ‘overarching document’ titled “Harmonized Horizons: Airspace Optimization in CAR-SAM Regions” is presented to establish the common collaborative goals and objectives, and the key initiatives agreed by CAR and SAM Regions

Action:	Suggested Actions are included in Section 3
Strategic Objectives:	• Safety • Air Navigation Capacity and Efficiency • Environmental Protection
References:	• Final Report of the GREPECAS/20 meeting, Salvador, Brazil, November 15-18, 2022 • Final Report of the GREPECAS/21 meeting, Santo Domingo, Dominican Republic, November 15-17, 2023 • ICAO Doc 9750 - *Global Air Navigation Plan* (GANP)

1. Introduction

1.1 The GREPECAS/20 Meeting, held from 15 to 18 November 2022 in Salvador, Brazil, agreed that the various initiatives referred to airspace optimization of CAR and SAM Regions should be grouped under a sole GREPECAS Programme, to develop, in a harmonized and interoperable manner, the GANP concepts for the optimization of airspace. Among these initiatives, elements of the GANP ASBU FRTO (Improved operations through enhanced en-route trajectories) thread of the GANP are considered, leading, in the middle term, to a Free Route Airspace (FRA), as follows:

FRTO B0/1 :	Direct routing (**SDR**)
FRTO B0/2 :	Airspace planning and flexible use of airspace (**FUA**)
FRTO B0/4 :	Pre-validated and coordinated Air Traffic Service (ATS) User preferred Routes (**UPRs**)
FRTO B1/1:	Free route airspace (**FRA)**

1.2 Decision GREPECAS/20/01 was adopted to amend and replace the CAR/SAM Projects A1, referred to implementation of Performance-Based Navigation – PBN, considering that, since sixth edition of GANP, the PBN is declared as a support to achieve the APTA (Improve arrival and departure operations) module.

1.3 The GREPECAS/21 Meeting (Santo Domingo, Dominican Republic, November 15-17, 2023) agreed on grouping all CAR and SAM initiatives to develop, together with industry, the concepts for the optimization of airspace that encompass Aviation System Block Upgrade (ASBU) threads/elements, mainly the Free Route Operations (FRTO) and the APTA (Improve arrival and departure operations). The importance of including the evaluation of Communications, Navigation and Surveillance (CNS)/Air Traffic Management (ATM) enablers and the optimization of longitudinal separation in continental space was also highlighted. The Meeting recognized that, to enhance the implementation of the elements of APTA and FRTO, it is necessary to:

a) support and reorient the optimization of the airspace structure of the CAR/SAM Regions in a harmonized and coherent manner, strengthening the ongoing implementations;
b) promote the activities of the CAR/SAM States and organizations for the effective implementation of Volume III of the CAR/SAM ANP; and
c) generate environmental benefits through fuel savings and reduction of CO2 emissions.

1.4 Consequently, the Decision GREPECAS/21/07 approved the CAR/SAM Airspace Optimization Programme and the NEOSPACE-1 Project replacing the A-1 CAR and SAM Projects. The mentioned decision requested NEOSPACE-1 project to develop an Action Plan for the implementation of the Project, integrating the participation of States, Regional Implementation Groups, Industry, and all concerned parties, as well as requested the industry and Data providers to provide data for the metrics and performance indicators required for the NEOSPACE-1 Project in GREPECAS/22.

1.5 Throughout the current year, the Regional Implementation Groups; NACC/WG and SAM/IG, supported by their contributory bodies and industry, have achieved meetings, activities and deliverables, deploying the ongoing FRTO initiatives. As well, the coordinators/rapporteurs of implementation groups and IATA and CANSO, together with the Secretariat (NACC and SAM Regional Offices), are analysing the implementation of the FRTO and APTA elements/modules, recognizing dissimilar scenarios in both regions, referred to the maturity of the initiatives, the airspace structure (upper/lower, continental/Oceanic, etc.), interfaces with the NAM Region, mayor air traffic flows, gap analysis on CNS facilities and services, etc.

1.6 In the next paragraphs below, the most relevant results in the implementation of the Airspace Optimization Programme for the CAR and SAM Regions, as well as the coordination made between both regions under NEOSPACE-1 Project are presented.

2. Analysis

2.1 CAR Region

AOTF CAR Airspace Concept

2.1.2 As explained in paragraph 1.5, a draft of the CAR Airspace Optimization Concept prepared by the NACC/WG Airspace Optimization Task Force (AO/TF) has been analysed with SAM Region planning bodies, and IATA. This concept represents a significant step towards enhancing the efficiency and safety of airspace management within the CAR Region, paving the way for future operational improvements. In that sense, the concept is being harmonized with the adjacent SAM Region.

Submission of SDR Guidelines to CAR States

2.1.3 At the Third Meeting of the NACC/WG Airspace Optimization Task Force (AO/TF/3), Fifth Meeting of the NACC/WG ATFM Implementation Task Force (ATFM/TF/5), and Seventh Meeting of the CANSO IATA ICAO Free Route Airspace (CIIFRA/7) Team (AO/TF/3/ATFM/TF/5/CIIFRA/7) held in Mexico City, Mexico, from 25 to 29 September 2023, a pivotal decision was made to initiate Strategic Direct Routing (SDR) as a part of our collective efforts to optimize airspace management and enhance aviation efficiency in the NAM/CAR Regions. During the meeting, a practical exercise was conducted as an example to assist States/Organizations in performing an assessment of their capability to engage in SDR trials. Guidance material was provided to all participants and is available to all via the following link on the ICAO NACC website:

SDR Guidance Material

CIIFRA Updates

2.1.4 Updates regarding the Free Route Airspace (FRA) CIIFRA) have been provided, outlining the progress and plans for 2024 and beyond. These updates are crucial for maintaining momentum and ensuring that the FRTO initiatives leaded to a FRA continue to evolve in line with regional objectives.

- Mexico's SDR Trial: SENEAM continues to advance the SDR project, with 45 User Preferred Route (UPR) r outes now available and trials commencing in Merida airspace. Effective 1 July 2024, direct routes from Mexico City Area Control Centre (ACC) to MMUN have been implemented daily from 0000 – 1200 UTC.

- Participation: Currently, 12 airlines, including major carriers such as American Airlines, Delta Airlines, and United Airlines, along with cargo and general aviation entities, are actively involved in CIIFRA initiatives.

- Inter Flight Information Region (FIR) SDR Trial: COCESNA and SENEAM initiated an inter FIR SDR Trial involving major airlines like American Airlines, Delta Airlines, United Airlines, and Aeromexico, with plans for temporary suspension in September 2024 for system updates.

- Route Standardization Efforts: Efforts to standardize flight plan filing procedures in the Latin America region are underway, supported by ICAO NACC recommendations to streamline Aeronautical Information Publication (AIP) and improve accessibility.

These developments underscore CIIFRA's commitment to enhancing airspace efficiency and operational flexibility across the region. Key actions include advancing SDR implementations, fostering collaboration with international partners like EUROCONTROL, and advocating for standardized procedures to optimize flight operations. Fourth Meeting of the NACC/WG Airspace Optimization Task Force (AO/TF/4), Sixth Meeting of the NACC/WG ATFM Implementation Task Force (ATFM/TF/6), and Eighth Meeting of the CANSO IATA ICAO Free Route Airspace (CIIFRA/8) Team (AO/TF/4/ATFM/TF/6/CIIFRA/8) to be held in Havana, Cuba from 23 to 27 September 2024, for further discuss updates and plans.

Request for Collaboration Across ATM-Related Disciplines

2.1.5 An initial analysis on the roadblocks and challenges faced by CAR States has indicated that there are several factors in the areas of Aerodromes and Ground Aids (AGA), Aeronautical Information Management (AIM), CNS, Meteorology (MET) that require further collaboration with the other NACC WG TFs with Subject Matter Expertise in those respective areas. This collaborative approach is essential for shaping the future of ATM, identifying potential roadblocks, and fostering a comprehensive understanding of the challenges and opportunities ahead.

2.2 SAM Region

Guide for Implementation of FRTO

2.2.1 A draft Guide for implementation of FRTO was developed with support from the RLA 06/901 Project (SAM Regional Office). Attached for ease of reference as **Appendix A** to this WP, and is available for consultation in the following link:

Draft Guide for implementation of FRTO

2.2.2 The FRTO Guide was shared for contributions and adoption by the CAR Region, through the NEOSPACE-1 project of the GREPECAS, aimed to obtain a unique implementation guide in the CAR/SAM Regions. This is important to guarantee a harmonized implementation across regions, particularly at the interface between the CAR and SAM Regions.

2.2.4 Before the GREPECAS/22 meeting, The SAM Airspace Study, and Implementation Group (GESEA) held one meeting of Subgroup 1 – Airspace Planning (SG1 PLANESPA) and four meetings of the FRTO Task force. Results of these meetings will be reported below.

2.2.5 The Sixth virtual meeting SG1 PLANESPA fulfilled the main purpose of carrying out monitoring of initiatives for optimization and resilience of South American air space within the scope of the ATM, as well as optimizing air operations in the region. 45 delegates from 10 SAM States participated, as well as representatives from airlines and industry.

Status of Implementation FRTO – UPR

2.2.6 Currently Brazil and Venezuela have UPRs published in full. In Brazil via the DECEA`s AISWEB page (see the link below) and Venezuela through the AIP Supplement C04/24-A04/24. It is important to note that Ecuador, Panama, and Peru published Aeronautical Information Circulars (AICs) relating to the implementation of the UPRs SPJC/KATL and KATL/SPJC. Uruguay is developing an UPR implementation project, in coordination with Delta Airlines. The project has included a period of testing, evaluation by the regulator and a proposal for publication in the AIP ENR 3.5.

Project Proposal in the AIP ENR 3.5

Status of Implementation FRTO – SDR

2.2.7 The Implementation status of SDR in the SAM Region is the following:

a) Brazil – Published in ENR 1.9, covering most of the continental airspace, excepting only the highest demand/complexity area close to Sao Paulo and Rio de Janeiro. Revision carried out in 2024 increased SDR air space by 5.5%.
b) Chile – Published in AIC 19/20, covering a portion of oceanic air space.
c) Ecuador – Published in ENR 1.10 (Item15 del FPL), covering the entire Guayaquil FIR.
d) French Guyana – Published in AIP CAR SAM NAM ENR 2.2-5, covering the oceanic air space of the FIR Cayenne. In this case, the airspace is named “FRA CELLS”.
e) Guyana – Published in ENR 1.10, covering the entire Georgetown FIR.
f) Peru – Republished via Supplement AIP 06/24, covering the part of the oceanic air space that has Very High Frequency (VHF) communication coverage and radar surveillance.
g) Surinam – Published via Supplement AIP 01/24, covering the entire Paramaribo FIR.
h) Venezuela - Republished via Supplement AIP C03-A03/24, covering most of the FIR Maiquetia, except for the portion in which there is no radar surveillance coverage and/or there are themes related to VHF communication coverage.

SDR SAM Pacific

2.2.8 Delta Airlines has made a proposal to implement a cross-border SDR in the oceanic airspace of the FIRs Panama, Bogota, Guayaquil, Lima, and Antofagasta. Delta Airlines' proposal is to implement SDR airspaces and insert additional “floating” waypoints (not connected to ATS routes) at the limits of the oceanic part of the aforementioned FIRs, with the aim of providing greater flexibility in the planning of flights, allowing a reduction of the flight distance/time and the consequent fuel savings and CO_2 reduction. Furthermore, it would allow for more effective planning based on prevailing winds and avoid adverse weather conditions during the flight planning phase. The proposal would be to implement it in two phases, with the first “North” phase involving FIRs Panama, Bogota, and Guayaquil and the second “South” phase, involving FIRs Guayaquil, Lima, and Antofagasta. Colombia, Ecuador, and Panamá agreed the implementation of the first phase of the SDR Pacifico SAM, involving the FIR Panama, Bogota, and Guayaquil on 28 November 2024.

FRTO implementation strategy

2.2.9 Aligned to CIIFRA initiatives, the GESEA/PLANESPA requested to the States their FRTO implementation strategy, with a view to conforming the SAM strategy and targets for FRTO Implementation, which would be incorporated into the Implementation Guide, as well as, if deemed appropriate, in the RANP CAR/SAM Vol. III. To facilitate this activity, IATA is the coordinator of the FRTO implementation body, GESEA SG1.

Aeronautical Publication

2.2.10 UPR and SDR publication models are available in the Appendices E and F of the FRTO Implementation Guide. In this sense, SAM States should use these UPR and SDR publication models to update published aeronautical information or in future implementations, with a view to ensuring necessary harmonization.

2.2.11 Regarding the placement of FRTO publications in the AIP, after the analysis carried out at the FRTO/7 meeting and consultations carried out with AIM experts, UPRs should be published in ENR 3.5 (other routes) and SDR should be published in ENR 2.2 (Other regulated air spaces).

2.2.12 The GESEA/PLANESPA preliminarily discussed the need/feasibility of publishing procedures applicable to UPR and SDR in the Regional Supplementary Procedures, (SUPPS), which would lead to the need for specific publication in the AIP ENP 1.8. The establishment of regional supplementary procedures for UPR and SDR could be an additional way of guaranteeing harmonization between the NAM, CAR and SAM Regions.

FRTO Action Plan

2.2.13 The SAM FRTO Action Plan, establishing the priorities that must be considered in 2024/2025 is attached as **Appendix B** to this Working Paper.

2.3 Common CAR/SAM framework for FRTO

2.3.1 Due to administrative issues, the NACC AO/TF/4/ATFM/TF/6/CIIFRA/8 meeting and the NACC/WG/9 had to be postponed to late September 2024. These delays resulted in the inability to collate all relevant information from CAR States/Territories/Organizations related to Airspace Optimization in time for 2 September 2024 deadline for submission of Working Papers (WPs) for the GREPECAS/22 meeting. The NACC/WG AO/TF will provide supplementary information during the GREPECAS/22 meeting based on relevant information received and conclusions/decisions made during both the AO/TF/4/ATFM/TF/6/CIIFRA/8 and the NACC/WG/9 meetings.

2.3.2 The Thirty Second South American Implementation Group Meeting (SAMIG/32) will be held On-line from 18 to 20 September 2024, few days before the NACC/WG/09. SAMIG/32 will discuss the information presented in this paper, and the action plan. The meeting will provide feedback, contributions, and adequate validations for the harmonization framework and related documents.

2.3.3 The following activities aimed at harmonizing FRTO implementation in the CAR/SAM Regions, including the adoption of a unique FRTO implementation guide and the overarching document, was/is scheduled to fulfil the mentioned implementation:

a) **9 September 2024 or before**, presentation of this WP to GREPECAS/22 (virtual phase) as a joint CAR/SAM effort, to report the status of FRTO implementation in the CAR/SAM Regions, as well as the adoption of the FRTO Implementation Guide and/or Action Plan for the asynchronous (virtual) phase of GREPECAS22. This WP was presented to AO/TF/4/ATFM/TF/6/CIIFRA/8, NACC/WG/9, and SAMIG/32 meetings.
b) **18 -20 September 2024**, SAMIG/32 Virtual. Analysis of this WP. Follow-up of Implementation, execution, and optimization activities within the framework of GESEA Action Plan.
c) **23-27 September 2024**, Havana, Cuba, AO/TF/4/ATFM/TF/6/CIIFRA/8 meetings analysed this WP.
d) **30 September to 4 October2024**, during the NACC WG/9 of Mexico, a virtual session of NACC/WG and SAM/IG was held for agreements and joint formulation of conclusion/approval of FRTO Implementation Guide, Concept of Operations (CONOPS), action plans for the FRTO, development from NEOSPACE-1.
e) **7-10 October 2024**. Four days. Presentation and discussion of this WP (updated version) in the virtual phase of GREPECAS22. Analysis of adoption of the FRTO Implementation Guide, and the overarching document, etc.
f) **11 October 2024**. Conclusion/Decision from the virtual phase of GREPECAS22. Report drafted.

2.3.4 Supporting the harmonization, the CAR/SAM Team has drafted an ‘overarching document’ titled ¨*Harmonized Horizons: Airspace Optimization in CAR-SAM Regions*¨. See **Appendix C**. Under this overarching document, the CAR/SAM actions and activities shall be included to ensure the timely harmonized deployment of FRTO.

2.3.5 The collaboration between the ICAO NAM/CAR and SAM Regions is vital to achieving the overarching goals of Airspace Optimization and ensuring the safe, efficient, and sustainable management of global air traffic. By working together, leveraging shared expertise, and addressing regional complexities, both regions can enhance their airspace capabilities and contribute to the global aviation community's advancement. This document serves as a bridge, reinforcing the commitment to collaboration and continuous improvement while respecting the unique needs and goals of each region.

2.3.6 Recognizing the unique challenges and complexities of the NAM Region, efforts to align with the CAR and SAM regions will require more extensive discussions and tailored strategies. The higher traffic volumes and operational demands in NAM Region necessitate a differentiated approach, ensuring that integration is both effective and sustainable, while fully addressing the distinct needs of this critical region.

2.3.7 Consequently, a reviewed version of the NEOSPACE-1 project description is attached as **Appendix D**.

2.4 Conclusions

2.4.1 The CAR and SAM Regions, through their working groups for airspace improvement, the CIIFRA initiative, and the collaboration of IATA, with the support of the Secretariat, have worked together for the implementation of the FRTO elements within the framework of the NEOSPACE-1 project. A special harmonization and alignment effort was developed, for which, in both Regions, documents and guides have been prepared, which have been analysed and adapted to each other to obtain a common reference.

2.4.2 In view of the above, in order to supersede Decision GREPECAS/21/07, the following draft Decision is submitted for consideration by GREPECAS/22, as follows:

<table>
<tr><td colspan="4">DRAFT DECISION
GREPECAS/22 APPROVAL OF THE HARMONIZED NEOSPACE-1 PROJECT VERSION 1.0 AND SUPPORT DOCUMENTS</td></tr>
<tr><td colspan="3">What:
That,

a) GREPECAS meeting approves:

i) the Airspace Optimization Programme - NEOSPACE-1 project VERSION 1.0 (Attachment D of WP19),
ii) the overarching document ¨Harmonized Horizons: Airspace Optimization in CAR-SAM Regions” (attachment C of WP/19),
iii) the CAR/SAM Guide for the implementation of improved operations through enhanced en-route trajectories (FRTO) (attachment A of WP/19),
b) that States, organizations and implementation groups, working jointly with Industry, strength their activities and harmonize their actions plans to the documents mentioned in a), b) and c), and
c) the industry and Data providers provide data for the metrics and performance indicators required for the NEOSPACE-1 Project.</td><td>Expected impact:
☐ Political / Global
☒ Inter-regional
☒ Economic
☒ Environmental
☒ Operational/Technical</td></tr>
<tr><td colspan="4">Why:
To strength and harmonize the optimization of the CAR/SAM airspace in terms of efficiency, capacity, safety and environmental protection, and to facilitate the implementation of Volume III of the CAR/SAM RANP, aligned to the GANP threads FRTO and APTA.</td></tr>
<tr><td>When:</td><td>a) immediately; b) and c) GREPECAS/23</td><td colspan="2">Status: ☒ Valid / ☐ Superseded / ☐ Completed</td></tr>
<tr><td>Who:</td><td>☒ CAR/SAM States and Territories
☒ ICAO NACC/SAM ☒ Other:</td><td colspan="2">CANSO, COCESNA, IATA and Coordinators of the NEOSPACE-1 Project</td></tr>
</table>

3. Suggested actions

3.1 The Meeting is invited to:

a) note of the information presented in this Working Paper;
b) note of the ongoing process for harmonization, performed in the CAR and SAM working groups;
c) analyse and, if appropriate, adopt the drafted Decision in section 2.4; and
d) discuss any additional action that is considered necessary.

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APPENDIX A

INTERNATIONAL CIVIL AVIATION ORGANIZATION
SOUTH AMERICAN REGIONAL OFFICE

GUIDE FOR THE IMPLEMENTATION OF IMPROVED OPERATIONS THROUGH ENHANCED EN-ROUTE TRAJECTORIES (FRTO)

[Draft 2.5 – 09 September 2024]

GUIDE FOR THE IMPLEMENTATION OF IMPROVED OPERATIONS THROUGH ENHANCED EN-ROUTE TRAJECTORIES (FRTO)

RECORD OF CHANGES

Version	Date	Change	Pages
Initial DRAFT 0.0	9 February 2024 Prepared by Robson Batista	Original – Spanish Draft	All
Initial DRAFT 0.1	29 February 2024 Following FRTO/5	Original – Spanish Draft	All
Initial DRAFT 1.0	8 March Following GESEA/7	Original – Spanish Draft	All
Initial DRAFT 1.1	15 March Following WEBINAR	Original – Spanish Draft	All
DRAFT 2.0	**8 July 2024, Harmonization to English version**	**Original - English Draft**	**All**
DRAFT 2.5	Proposal for adoption by GREPECAS22	**Original - English Draft**	**All**

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1 FOREWORD

The implementation of the ATS SAM route network *versioning* concept was approved at the SAM/IG/3 meeting (Lima, Peru, 20-24 April 2009). The objective was to achieve integrated development, conducting a broader route network analysis based on data on air traffic flow and fleet navigation capacity, with a view to eliminating unused routes and excluding or reducing "*conventional*" routes, in order to make way for RNAV-5 navigation in regional airspace above FL245.

Building on the concept of route network versions over the last decade, the SAM/IG and ATS/RO forums were responsible for the complete restructuring of the SAM ATS route network, which involved the implementation, realignment (less distance flown = less CO2 emissions) and elimination of hundreds of conventional ATS routes. The initiative also facilitated the implementation of the flexible use of airspace (FUA) concept.

At present, the use of **fixed ATS routes alone can no longer provide the efficiency required** for airspace users to achieve fuel savings and reduce CO2 emissions. The **natural evolution of airspace optimisation** involves the implementation, in the short and medium term, of **improved operations through enhanced en-route trajectories (FRTO)**[1], as defined in the Global Air Navigation Plan (GANP).

The GANP represents the strategy to achieve a global interoperable air navigation system that provides safe, secure and efficient air transport, while limiting the impact of aviation on the environment. The GANP promotes performance-based planning, using the six-step approach. The implementation of this global methodology is set forth in Volume III of the Regional Air Navigation Plan (CAR/SAM RANP). Volume III was approved by GREPECAS in 2022, but CAR and SAM States still need to endeavour to insert their data in the planning tables and strengthen the performance-based planning processes.

Since 2020 (beginning of the pandemic), the SAM region has focused on the South American airspace optimisation strategy through the application of the GANP FRTO B0/B1 - DCT module, implementing strategic direct routing (SDR), as an initial step in a broader implementation and evolution towards free-route airspace (FRA). At the same time, it has been noted that the implementation of FRTO can help close gaps in ATM and CNS in the Region, as well as strengthen and ensure safety.

This Guide meets the objective of integrating FRTO theoretical concepts into the framework of airspace optimisation developments in the Region, in order to strengthen and broaden them. At the same time, it seeks to **facilitate interoperability** between the SAM Region and the NAM/CAR Region, recognising that this implementation covers, in general, flight flows that originate from, and/or cross, the three Regions.

The Guide aims to **bring together the efforts and collaborative and trans-regional work** of air navigation planners, States, providers and industry.

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[1] *The ICAO GANP is published in English only. Regarding the free translation (into Spanish) of the term FRTO, it is considered that* ***'improvement'*** *refers to the end result, while* ***'enhancement'*** *focuses on the process and resources used.*

2 INTRODUCTION

*Note. - The list of acronyms, abbreviations and definitions can be found in **Appendix G** to this Guide. Reference documents are listed in **Appendix H**.*

2.1.1 The air transport industry plays a key role in global and regional connectivity, the economy, employment and business opportunities, trade, technological development, tourism and cultural exchange, emergency response, humanitarian aid, and regional development. However, despite its many benefits, the air transport industry faces major challenges, as well as environmental commitments, in the midst of a complicated international political and economic setting.

2.1.2 To overcome these challenges, ICAO Regions have adopted a number of initiatives and programmes aimed at improving air operations in terms of capacity, efficiency, safety and environmental sustainability. The GANP contemplates the development of the aviation industry through Aviation System Block Upgrades (ASBU), among which improved operations through enhanced en-route trajectories (FRTO)* allow for airspace optimisation.

2.1.3 To achieve airspace optimisation in the CAR/SAM Regions, the CAR/SAM Regional Planning and Implementation Group (GREPECAS), through Volume III of the Regional Air Navigation Plan (CAR/SAM RANP), provides guidance to the aviation community in the application of the performance management process and in the identification of relevant and timely operational improvements to the air navigation system.

2.1.4 At its twenty-first meeting held in Santo Domingo in 2023, the aforementioned Group presented the NEOSPACE-1 project as a driver of the airspace optimisation process, with a view to promoting airspace infrastructure optimisation in the CAR/SAM Regions, strengthening the implementation of Volume III of the ANP in the CAR/SAM Regions, and generating environmental benefits, including fuel savings and reduction of CO_2 emissions, with enhancement goals established on the basis of a defined baseline.

2.2 ICAO strategic objectives

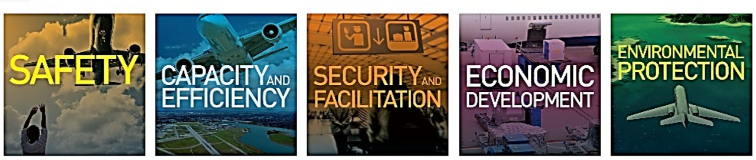
2.2.1 This Guide is directly related to ICAO strategic objectives, as described below:

a) Safety: Enhance global civil aviation safety.

b) Air navigation capacity and efficiency: Increase capacity and improve efficiency of the global civil aviation system.

c) Economic development of air transport: Foster the development of a sound and economically-viable civil aviation system.

d) Environmental protection: Minimise the adverse environmental effects of civil aviation activities.



2.3 Global and regional trend

2.3.1 The COVID-19 health emergency generated a new scenario in global aviation. According to IATA publications, in 2023, air transport almost fully recovered its pre-pandemic pace of activity, and is seen as a year of renewed financial profitability for the industry. Industry-wide passenger traffic, measured in revenue passenger-kilometres (RPKs), grew by 40.1% year-on-year until September 2023 and reached 92.9% of pre-pandemic levels. In the long term, global passenger traffic is projected to double by 2040.

2.3.2 In the SAM Region, the number of take-offs in 2020 decreased by 58.4% compared to the previous year, which represented a strong economic impact for the whole industry, and affected ANSPs due to the significant reduction in the number of aircraft operations. In 2023, the number of take-offs recovered, reaching 1.45% more compared to 2019. Despite the adverse economic environment in 2023, air transport in the SAM Region showed resilience, even achieving a slight growth compared to other Regions.

2.3.3 Significant challenges will persist in the SAM Region in 2024. There is a need to promote a competitive and sustainable aviation industry. This calls for work on efficient policies regarding air navigation and airport charges, reducing fuel costs, and expanding airport infrastructure. A simpler and more reliable regulatory environment for new market entrants should be encouraged in order to increase competition, expand air connectivity and benefit the user.

2.3.4 Recognising these challenges, the ATM community in the SAM Region is focused on supporting the growth and sustainability of air transport. This requires the promotion of a seamless, high-performance, as well as safer and more robust and resilient regional air navigation system.

2.4 Gaps and ambitions for improvement

2.4.1 In the continental airspace of the SAM Region, above FL245, en-route trajectories are mostly defined by a **network of fixed routes** with RNAV-5 specification, implemented between 2011 and 2020. In addition, around 10% of regional routes are still conventional (theoretically for radio aid-based navigation). Several States maintain a combination of RNAV-5 routes and conventional routes in their domestic airspace.

2.4.2 Regarding lower airspace in the Region, below FL245, in general, conventional routes still remain, including regional routes. However, several States are replacing them with RNAV-5 routes (for example: Brazil, Chile, and Peru).

2.4.3 There are different levels of implementation of strategic direct routing (SDR) in the SAM Region. It has already been implemented in all of the Amazonica, Cayenne, Guayaquil, Georgetown and Paramaribo FIRs, as well as in most of the Brasilia, Curitiba, Maiquetia and Recife FIRs. SDR has also been implemented to some extent in the Antofagasta, Lima and Santiago FIRs. There is an opportunity to expand SDR area in some FIRs, as well as to standardise existing aeronautical publications. The main objective is to achieve a uniform and cross-border implementation of SDR in all the FIRs of the CAR/SAM Regions.

2.4.4 There are various initiatives to implement user-preferred routes (UPRs), but there is a need to standardise their publication in the respective AIPs, and to establish a mechanism to facilitate access by aircraft operators to the entire route, by updating and publishing them on an appropriate website. It is important to note that UPRs must be used as an option in airspaces that lack the necessary conditions for SDR or FRA implementation, be they operational or infrastructural, such as, lack of adequate ATC sectorisation or gaps in ATS surveillance or VHF communications.

2.4.5 Progress has been made in the application of the "flexible use of airspace" (FUA) concept during the regional implementation of RNAV-5, which was supplemented by flight path optimisation involving a reduction of flight distances. However, permanently segregated areas, allocated to military activity, persist in several States.

2.4.6 Air traffic control centres (ACCs) in the Region have varying levels of automation. In some ACCs, conflict detection is a manual task performed by the air traffic controller (ATCO), based on paper or electronic flight strips.

2.4.7 On the other hand, the environmental impact from aviation emissions is significant. It affects different areas and varies depending on factors such as geographic location, the specific characteristics of the industry in each region, and economic and environmental conditions. The aviation industry and States have taken steps to address such impact through more efficient technologies, the development of aviation biofuels, the implementation of sustainable operating procedures, and efforts to improve air traffic efficiency.

2.4.8 ICAO has established the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) to supplement efforts to offset the amount of unabated CO2 emissions, through operational and technological measures and sustainable fuels. The implementation of CORSIA, which is a market-based measure, is being implemented in three phases, and entry into the programme will be mandatory as of 2027 for all States that have a 0.5% share of the world's revenue tonne-kilometres (RTKs) or that contribute to 90% of global cumulative RTKs, except least-developed countries, small island developing States and landlocked developing countries, unless they volunteer to participate. The expectation is that this programme will last until 2035, when the production of alternative fuels will increase and be used ostensibly in aviation.

2.4.9 The operational measures proposed by ICAO are related to the optimisation of operational procedures and air traffic management (ATM) measures to reduce greenhouse gas emissions. The Global Air Navigation Plan (GANP) contains most of the existing operational measures and will be available soon, including FRTO. The operational implementations foreseen in the GANP aim at an interoperable global air navigation system that guarantees acceptable levels of safety and ensures more environmentally sustainable and cost-effective operations. ICAO estimates that GANP implementation will reduce CO2 emissions by millions of tonnes.

2.4.10 The implementation of technological measures is also crucial for reducing CO2 emissions from aviation. Significant progress has been made over the last decades. Around 80% of aircraft in operation are more fuel-efficient per passenger-kilometre than aircraft in operation in the 1960s. Ongoing developments include engines that improve the bypass ratio and lighter, more heat-resistant materials for airframe construction.

2.4.11 Furthermore, advances in electric and hybrid aircraft technology will lead to lower consumption of fossil fuel and thus lower CO2 emissions. While technological measures significantly reduce emissions, their cost is high and incorporating these technologies into aircraft fleets can take time. At the same time, ICAO promotes the use of sustainable aviation fuels (SAF) among other initiatives. See **Appendix A** to this guide.

2.4.12 The evolution described in the GANP for FRTO (Blocks 0 and 1) is as follows:

- **Block 0:** En-route trajectories are improved through the use of more direct routes and collaborative airspace management processes and tools. ATCOs are assisted by tools for conflict detection and conformance monitoring.

- **Block 1:** Initial steps towards trajectory-based operations are presented through the improvement of Block 0 processes and system support or the deployment of new processes and system support where necessary.

2.4.13 In continental airspace, the main operational improvement is related to free-route airspace (FRA), as a continuation of direct routing introduced in Block 0.

2.4.14 The implementation of RNP routes may be considered for airspace where SDR or FRA cannot be deployed, or for connectivity between SDR or FRA and TMAs. It is also envisaged to apply these RNP routes in airspace requiring more complex processes that result in delays in the implementation of SDR or FRA.

2.4.15 As part of TMA optimisation, it is expected that A-RNP departure and approach procedures will be applied -- as already done in Chile -- considering that A-RNP approval of aircraft and operators includes the RNP-2 specification, which can be used for fixed-route airspace optimisation in airspaces of greater complexity and air traffic volume, mostly in the vicinity of the main TMAs of the Region, such as Bogotá, Buenos Aires, Panama, Lima, Santiago and Sao Paulo.

2.4.16 Collaborative airspace management will be enhanced with new functions, such as real-time airspace management (ASM) data exchange. Additional system capabilities, such as dynamic sectorisation, seek to align traffic demand with available capacity.

> *Note. - The implementation of the APTA module is foreseen as a supplement in the NEOSPACE-1 project to increase performance in the* ***capacity KPA****, in the capacity, throughput and utilisation focus areas.*

2.5 ICAO-driven FRTO planning. Ongoing activities

2.5.1 The Global Air Navigation Plan (seventh edition) encourages aviation community members to participate together to achieve an agile, safe, secure, sustainable, high-performing and interoperable global air navigation system.

2.5.2 At the same time, new demands on the aviation system, emerging technologies, innovative ways of doing business and the changing human role present challenges and also opportunities that require urgent transformation of the air navigation system for aviation to continue to drive social well-being in the South American Region.

2.5.3 The GANP emphasises performance-based air navigation planning in accordance with the six-step approach to performance-based planning set forth in Doc 9883. This methodology is also presented in Volume III of the CAR/SAM RANP. For reference, see the "Instructions for use of the template for Volume III of the Regional Air Navigation Plan - CAR/SAM RANP", approved in October 2021 by GREPECAS Conclusion 19/05, which sets out the six-step method, at the following links:

https://www.icao.int/GREPECAS/Documents/eCRPP03-Minute_1.pdf

https://www.icao.int/NACC/Documents/Meetings/2021/GRP19/GREPECAS19-InformeFinal.pdf

2.5.4 FRTO in the SAM Region is enabled by the implementation of several initiatives, such as: user-preferred routes (UPR), strategic direct routing (SDR) and free-route airspace (FRA).

2.5.5 Both SDR and FRA are part of the ICAO Global Air Navigation Plan and are included in the Aviation System Block Upgrades (ASBU) under the FRTO thread, blocks FRTO B0 and FRTO B1. The strategy proposed in this guidance material **is limited only to Blocks 0 and 1**, which are achievable within a **5-year time horizon (TBD)**.

Note. - The proposed strategy may evolve in the future to include the remaining parts of FRTO, such as Dynamic Airspace Configuration and large-scale cross-border Free-Route Airspace (FRA), FRTO B2/2 and FRTO B2/3 respectively.

2.5.6 At the regional level, ICAO will lead FRTO planning and implementation in the CAR/SAM Regions, through the CAR/SAM Regional Planning and Implementation Group (GREPECAS). Within the framework of the Airspace Optimisation Programme and the NEOSPACE-1 Project, it is expected that comprehensive guidance material on FRTO implementation will be provided to States, air navigation service providers and airspace users.

NEOSPACE-1 Project

2.5.7 The purpose of the NEOSPACE-1 Project is to support and reorient the optimisation of the CAR/SAM airspace structure in a harmonised and consistent manner, by strengthening ongoing implementations, furthering the activities of CAR/SAM States and organisations for the effective implementation of Volume III of the CAR/SAM RANP and generating environmental benefits through fuel savings and CO2 emission reductions.

2.5.8 According to project planning, FRTO and APTA elements and the respective KPIs will be selected (GANP performance-based planning process and Doc 9883). Performance improvement targets require the definition of a baseline for KPIs. With that baseline, it is possible to set performance improvement ambitions for a given KPI, within a defined timeframe. However, States/organisations can calculate/monitor other GANP KPIs or develop their own indicators according to their needs.

2.5.9 The execution of project activities will be coordinated through communication among project members, project coordinators and the programme coordinator through meetings of the CAR and SAM implementation groups. The project recognises the need to continue supporting the recovery of air connectivity in the CAR and SAM Regions, through efficiency and capacity optimisation. Strengthening of inter- and intra-regional harmonisation for FRTO and APTA implementation is envisaged.

2.5.10 Regarding the actual implementation of FRTO, close collaboration between the NACC/WG Airspace Optimisation Task Force and the SAM/IG Airspace Study and Implementation Group (GESEA) is essential to harmonise and expedite FRTO implementation in the CAR/SAM Regions, in order to generate flight efficiency and improve aviation in both Regions.

2.5.11 In order to meet the need for early benefits when States are unable to implement strategic direct routing (SDR) and to expedite coordination between ANSPs and airlines, a joint CANSO-IATA- ICAO Free Route Airspace working group, called **CIIFRA**, was established in 2021 to support the implementation of UPRs. It should be noted that SDR implementation is also part of CIIFRA's strategy, as well as its transition to FRA.

3 IMPLEMENTATION IN KEY PERFORMANCE AREAS (KPAs)

*Note. - The tables in **Appendix B (in English)** show the linkage of the GANP to the KPIs for each selected KPA, allowing for the identification of FRTO elements that contribute to the expected performance improvement.*

3.1.1 Key performance areas (KPAs) describe the priority areas where specific improvements and developments are needed to achieve the overall objectives of ASBU. Each KPA addresses a specific dimension of air navigation system operations and provides guidance on areas requiring special attention. FRTO implementation impacts several KPAs, as described below.

3.2 Efficiency KPA

3.2.1 The implementation of FRTO modules is aimed at improving performance in the **Efficiency** area, in focus areas: flight time, distance and vertical flight, impacting on fuel savings and CO2 emissions. Efficiency refers to the operational effectiveness and economic profitability of flight operations between city pairs, from a single flight perspective. In all flight phases, airspace users want to depart and arrive at the time they have selected and fly along the path they consider optimal. See examples taken from **Appendix B**:

KPA	Focus Areas	Most specific performance objective(s) supported	KPI	ASBU Operational Element	DESCRIPTION
Efficiency	Flight time & distance	Overcome route selection inefficiencies associated with route network design	KPI04: Filed flight plan en-route extension	FRTO-B0/1	Direct routing (DCT)
Efficiency	Flight time & distance	Overcome route selection inefficiencies associated with route & airspace availability as known at the flight planning stage	KPI04: Filed flight plan en-route extension	FRTO-B0/2	Airspace planning and flexible use of airspace (FUA)
Efficiency	Flight time & distance	Overcome route selection inefficiencies associated with route network design	KPI04: Filed flight plan en-route extension	FRTO-B1/1	Free-route airspace (FRA)

3.3 Capacity KPA

3.3.1 The FRTO-B1/2 "RNP routes" element impinges more specifically on an increase in the **capacity** of the en-route segment. The global air navigation system must maintain inherent capacity to meet the demand of airspace users at peak times and in locations with maximum occupancy, while minimising traffic flow restrictions.

3.3.2 In order to address future growth, capacity must be increased, together with efficiency, flexibility and predictability, to ensure that there are no adverse safety impacts, taking into account the environment. The air navigation system shall be resilient to service disruption and the resulting temporary loss of capacity. Examples:

Capacity	Capacity, throughput & utilization	Reduce ATCO workload (enroute)	KPI06: En-route airspace capacity	FRTO-B0/4	Basic conflict detection and conformance monitoring
Capacity	Capacity, throughput & utilization	Overcome capacity limitations attributable to route network design	KPI06: En-route airspace capacity	FRTO-B1/2	Required navigation performance (RNP) routes

3.4 Safety KPA

3.4.1 The implementation of FRTO modules allows for increased performance in the **safety** area, under the specific objective of avoiding lateral/horizontal navigation deviations, and improving early detection of conflicting ATC clearances.

3.4.2 Resolution A40-1 "ICAO global planning for safety and air navigation" endorsed the third edition of the Global Aviation Safety Plan (GASP) and the sixth edition of the GANP to serve as global strategic guidance for safety and air navigation, respectively.

3.4.3 The resolution also states that the GASP and the GANP must be implemented and kept up-to-date in close cooperation and coordination with all stakeholders, and that these plans will serve as a framework for the development and implementation of regional, sub-regional and national plans, thereby ensuring consistency, harmonisation and coordination of efforts to enhance the safety, capacity and efficiency of international civil aviation. The full content of the Resolution and its appendices on GASP and GANP matters, respectively, can be found at:

https://www.icao.int/Meetings/a40/Documents/Resolutions/a40_res_prov_es.pdf

GASP and GANP indicators

3.4.4 The seventh edition of the GANP has included new KPIs for the safety area. GREPECAS has started joint activities with the Regional Aviation Safety Group – Pan America (RASG-PA), in order to optimise the management of these indicators and avoid supplication of efforts in the capture and analysis of these data. For example, KPI20 "Number of aircraft accidents" has been monitored by RASG-PA for several years as part of its activities. See examples for KPI20 and KPI23:

Safety	TBD	Improve early detection of conflicting ATC Clearances (CATC) (en-route / departure / approach)	**KPI20: Number of aircraft accidents**	FRTO-B0/4	Basic conflict detection and conformance monitoring

Safety	TBD	Improve early detection of conflicting ATC Clearances (CATC) (en-route / departure / approach)	**KPI23: Number of airprox/TCAS alert/loss of separation/near mid-air collisions/mid-air collisions (MAC)**	FRTO-B0/4	Basic conflict detection and conformance monitoring

3.4.5 The GASP sets out its goals, targets and indicators in relation to the safety objective of "zero fatalities by 2030". In this regard, the GASP has identified Goal 6, related to the availability of appropriate infrastructure for safe air operations (see **Appendix C**), whose targets and indicators are shown in the following table:

Goal 6: Ensure the appropriate infrastructure is available to support safe operations	**6.1**	By 2025, maintain an increasing trend of States with air navigation and aerodrome infrastructure that meet relevant ICAO Standards.	• Number or percentage of infrastructure-related air navigation deficiencies by State, against the regional air navigation plans • Number or percentage of States having implemented infrastructure-related PQs linked to the basic building blocks

Goal 6: Ensure the appropriate infrastructure is available to support safe operations

3.5 Environment KPA

3.5.1 The performance goal for the environment KPA set forth in the GANP is "to maintain or improve environmental sustainability of aviation". The seventh edition of the GANP has neither defined the specific FRTO element nor developed indicators for this KPA, that is, there is not yet a harmonised definition of common environmental metrics. See **Appendix B.**

3.5.2 However, the contribution of ASBU module/element implementation to environmental protection is recognised, especially where it allows for a reduction in flight distance/time and vertical profiles through FRTO implementation, allowing aircraft to follow more direct trajectories.

3.5.3 By reducing flight distance, fuel savings can be estimated (for each flight and for all flights on the segment) compared to the previous trajectory configuration. Consequently, the amount of CO_2 associated to fuel saved can be estimated.

Note. - For ease of calculation, the CO_2 emitted is considered to be approximately 3.16 times the fuel consumed, expressed in kilogrammes.

3.6 Cost-effectiveness, access and equity, and flexibility KPAs

3.6.1 The ICAO GANP is in the process of completing or defining KPIs for these KPAs. The FRTO implementation approach may consider the development for these KPAs, based on GANP evolution in subsequent editions. See **Appendix** B**.**

4 FRTO IMPLEMENTATION ASSUMPTIONS

4.1.1 Taking as operational scenario the CAR/SAM airspace, and identifying the aforementioned performance improvement ambitions, this Guide makes the following assumptions:

a) Airlines will continue making efforts to modernise their aircraft fleets in order to accomplish performance-based navigation (PBN), supported mainly by GNSS. The *"best equipped, best served"* concept will apply.

b) ATFM shall be strengthened in the Regions, evolving towards an integrated cross-border service, in order to be prepared to manage the capacity-demand mismatch, with a strong emphasis on achieving the least impact of flow measures on operators.

c) FRTO implementation helps ATM system capacity absorb the growth in air traffic demand.

d) The States of the Regions, depending on the financial situation, will continue to make efforts to modernise their air traffic control systems in accordance with their operational needs and new developments in the industry.

e) The States of the Regions will continue to make efforts to increase ATC capacity as necessary to meet air traffic demand, primarily through appropriate ATC sectorisation.

f) The States of the Regions will continue to take action as needed to reduce the environmental impact that may result from civil aviation activities.

g) The implementation of the FRTO concept must meet safety criteria, be compatible with existing operations and future systems, and expand and connect to adjacent airspace.

h) The application of the FRTO concept must consider the defence and security requirements of military bodies. The implementation of FUA, based on ICAO Doc 10088, establishes an appropriate framework for civil-military cooperation.

i) The vertical and horizontal boundaries of the regions in which FRTO is applied must preferably be based on operational requirements, not necessarily on FIR geographical boundaries, in order to take full advantage of its applicability. A study must be undertaken to align sectorisation with the implementation of FRTO airspace.

j) SDR and FRA will be implemented in a harmonised and standardised manner in the States of the Regions, facilitating the evolution to cross-border application. The implementation should involve the support of States and ANSPs to conduct trials to assess feasibility, efficiency, positive environmental impact and safety aspects.

5 FRTO IMPLEMENTATION ENABLERS

5.1 Communication, navigation, surveillance

Communication

5.1.1 VHF coverage is essential for FRTO implementation in continental airspace, while other means of communication such as HF or CPDLC may be used in remote and oceanic airspace. However, it will be up to each State to assess the implementation of FRTO in areas that have coverage gaps, provided that an operational risk analysis is carried out and other safety measures, such as a LoA between the ACCs involved, are taken as necessary.

In the short term, it is expected that SDR and/or FRA will be implemented in oceanic airspaces with low complexity and/or low air traffic volume. However, the option of implementing UPRs should be mainly considered in oceanic airspaces, taking into account that pre-coordination with ATC and/or ATFM reduces the need for ATCO intervention.

5.1.2 In the medium and long term, among the proposed solutions for bridging communication coverage gaps without the need for avionics upgrades, the VOICE project offers very satisfactory results as to the technical feasibility of VHF systems based on low earth orbiting (LEO) satellites.

5.1.3 With this new communication technology, traffic in oceanic and remote airspaces would be handled in a similar way to continental airspace, allowing for FRTO implementation and a reduction of separation minima without compromising safety. Likewise, the VOICE project will conduct some cross-border operations between adjacent flight information regions (FIRs) belonging to different countries and under the responsibility of different air navigation service providers (ANSPs).

5.1.4 The VOICE project would therefore produce a viable technical solution for VHF voice and data link communication in ground metric waves. Gap-free VHF communication between continental and oceanic/remote airspaces will allow users to overcome the current coverage limitations of ground systems, while reducing aviation-related CO2 emissions through the use of more efficient trajectories.

Navigation

5.1.5 Performance-based navigation (PBN) is an indispensable tool for optimising airspace using FRTO, responding to the increasing complexity of aviation operations. By enabling more direct and efficient trajectories, PBN reduces the distance flown, saves fuel and contributes to environmental sustainability. Its adaptive flexibility is crucial to cope with changing operational conditions, optimise the use of airspace and promote efficient traffic management.

5.1.6 The precise departure and arrival procedures offered by PBN, such as RNAV and RNP, not only increase safety, but also help aircraft to circumvent airspace restrictions and respond to unexpected events, making operations more resilient. More efficient trajectories not only reduce flight time, benefiting airlines economically, but also contribute to more sustainable and safer aviation.

5.1.7 In summary, airspace optimisation using PBN is vital to address contemporary operational challenges while promoting efficiency, safety and sustainability in the global aerospace landscape. Collaboration among stakeholders is essential to ensure the continued success of this innovative approach to aviation.

5.1.8 At present, RNAV routes have an RNAV-5 navigation specification. However, States should consider applying a more robust RNP specification, for example RNP2, to accommodate a greater number of aircraft in a safe and sustainable manner.

ATS surveillance

5.1.9 ATS surveillance coverage is important for FRTO deployment in continental airspace, while surveillance in oceanic airspace could be based on other means, such as ADS-C/CPDLC and space-based

ADS-B. In the case of space-based ADS-B, it would be important to identify the means of communication used, taking into account that ATCOs would have similar surveillance to that in continental airspace, but would not have a communication system that would allow the same intervention capability as VHF voice communication.

5.1.10 It is important to highlight that it is essential that States consider the installation of communication and surveillance equipment that would reduce or eliminate coverage gaps that could prevent or hinder FRTO implementation, as well as longitudinal separation optimisation.

5.1.11 UPRs may be more appropriate for use in airspaces that lack ATS surveillance or have more significant coverage deficiencies, taking into account that these are routes previously coordinated with the ANSP, where a more accurate assessment of the impact on operations could be made.

5.1.12 In those remote airspaces where, due to their geographical location, optimal ATS surveillance is not possible, States must consider the feasibility of developing appropriate procedures to enable FRTO with the least possible impact on separation in surrounding airspaces with ATS surveillance.

5.2 ATS services and automation

5.2.1 There is a need to use automated tools to indicate the status of upcoming airspace reservation and restriction activities because all stakeholders must have the same information on the intended profile and route of a flight, both in the initial flight plan and in any subsequent updates of that information.

5.2.2 Special attention must be paid to ATS service continuity, especially in transition areas between an airspace where SDR or FRA is applied and another using the ATS fixed route system (and *vice versa*). Additional procedures must be agreed to ensure continuity in the provision of the structured ATS service.

5.2.3 Where appropriate, consensus should be reached in the medium term among States on the minimum (lateral/longitudinal) separation to be applied between aircraft in the FRA. For UPR or SDR routes, minimum separation requirements in accordance with the required navigation specification on the respective route must be applied.

5.2.4 In the medium/long term, it will be necessary to implement automated tools to indicate the status of upcoming airspace reservation and restriction activities, because all stakeholders must have the same information on the intended profile and route of a flight, both in the initial flight plan and in any subsequent updates of that information. In the absence of such automated tools, it is the responsibility of the aircraft operator to plan flights avoiding airspace reservation and restriction areas, as set out in aeronautical publications or information provided by the ATFM or ATC unit.

5.3 AIDC system – Data communication between ATS units

5.3.1 The AIDC system seeks to improve the efficiency of coordination and transfer of control between ATS units -- in this case area control centres -- by replacing voice communication (ATS voice channel) with an automatic exchange of messages. This element represents a first automation step in the evolution of coordination and transfer of control between neighbouring ATS units to ensure that all associated and necessary flight information is available to the other unit as agreed.

5.3.2 In the SAM Region, the implementation of AIDC (referred to in the GANP under FICE B0/1 element), seeks to promote the optimisation of ATS coordination and the efficient management of aircraft flow data. At the same time, AIDC has been identified as an element that mitigates ATS coordination errors, called LHDs. These events are being handled and reduced in number, after showing more incidence at some transfer points, between ACCs in the Region. It is estimated that 20% of 102 (bilateral) connections have been implemented between control centres in the SAM Region. There is a subgroup in the Region driving this implementation, which is studying a broader application of AIDC functions.

5.3.3 Notwithstanding the above, it is important to note that the AIDC is not a basic requirement for SDR implementation in the short term, taking into account that cross-border SDR implementation is not expected in the short term, that is, the transfer of aircraft between ACC units will take place at a significant point published and agreed in ATS letters of agreement.

5.4 MTCD tools – Flight data processing (FDP)

5.4.1 The medium-term conflict detection (MTCD) tool (defined in ASBU as FRTO-B0/4*) is required for the FRTO-B1/1 FRA element, as it enables safety maintenance and reduces ATCO workload through early and systematic conflict detection and conformance monitoring.

5.4.2 MTCD assists the ATCO in conflict identification and planning tasks by providing automated early detection of potential conflicts; facilitates the identification of flexible routing paths and absence of conflicts; assists with the identification of aircraft that constrain conflict resolution or occupy a flight level requested by another aircraft.

5.4.3 The monitoring aids (MONA) function provides the controller with warnings if the aircraft deviates from free airspace or planned trajectories, and reminders of ATCO instructions to be issued. MONA may include monitoring of flight progress, as well as of lateral, longitudinal, vertical and **cleared** flight level (CFL) deviations.

**Note. - The Guide proposes to consider it as an enabler of FRTO implementation.*

5.5 Aeronautical information management (AIM)

5.5.1 Aeronautical information management (AIM) is a crucial part of the safe and efficient operation of the civil aviation system, involving the collection, organisation, processing, dissemination and use of aeronautical information relevant to pilots, air traffic controllers, airlines and other aviation stakeholders. The AIM unit shall assess and adopt processes to facilitate implementation and ensure safety.

5.5.2 ATS reporting functions are typically placed under AIM management in the Region. Similarly, aeronautical charts are often managed by AIM.

5.5.3 Flight planning

Short term (up to 5 years)

5.5.3.1 Flight plans will be distributed to ATS providers, relevant military organisations and other stakeholders (may vary according to State requirements). The improvement of FPL messaging shall be addressed and some deficiencies corrected. The flight plan management system will ensure appropriate flight profile calculation.

5.5.3.2 Current flight plan systems are expected to be able to support SDR implementation, taking into account that cross-border SDR implementation is not expected in the short term.

Medium term (5-10 years) and long term (10 years or more)

5.5.3.3 The automatic exchange of flight data between ACCs must consider the possibility of transfer at random points, enabling cross-border SDR or FRA implementation. The possibility of flight planning across two or more FIR boundaries will be provided. This will require the flight plan processing system to calculate and communicate with all ACCs belonging to the same airspace where FRTO is applied.

5.5.3.4 Real-time updates of airspace availability must lead to a recalculation of the flight profile sent by the flight plan processing system prior to FPL distribution. To ensure that subsequent en-route corrections can be provided to the affected flights, it will be necessary to define an appropriate distribution time parameter. Once this parameter has been exceeded and FPL has been distributed, no further route updates shall be processed.

5.5.3.5 It is recommended that the flight plan processing system may propose routes based on shortest distance and/or alternative FLs above or below airspace reservation or restriction areas. In areas where coordination procedures and airspace conditions permit, users may plan to fly through segregated or reserved airspace and await tactical rerouting in the event that no areas are available.

5.5.3.6 The user will need to be aware of all relevant reservation or restriction activities in FRA or SDR airspace to permit the selection of routes to avoid them. In the event that FRA or SDR airspace is transient, the route selected will be based on intermediate points published to this end, in order to avoid inadvertent entry into segregated or reserved airspace.

5.5.3.7 The flight plan processing system will enable the correct processing of the flight plan and the verification of the transition from ATS fixed route network airspace to FRA or SDR airspace and *vice versa*, especially when the latter is applied during limited periods, for example, only at night. In such cases, the flight plan processing system will verify the flight plan to ensure compliance with the duration parameters of the respective SDR or FRA airspace.

5.5.3.8 In the case of large-scale FRA applications, flight plan distribution to the appropriate ATC unit and ATC sectors must be ensured, hence the importance of having up-to-date information on active sector configurations. Furthermore, ATC units, airspace users and other units involved shall have access to exactly the same information for both the initial flight plan and subsequent updates.

5.5.3.9 In addition to the normal flight plan validation rules in the flight plan processing system, the planned route in FRA airspace will be considered invalid if:

a) it does not comply with the FRA-published horizontal entries/exits, the FRA departure/arrival connection points, and any other use of airspace; and

b) crosses a reserved or restricted area whose coordination procedures and airspace conditions do not permit entry.

5.5.4 Publications and aeronautical charts

5.5.4.1 Lateral and vertical limits, duration, conditions and requirements for FRA and SDR application will be published in the aeronautical information publication (AIP). UPRs must be included in the route playbook.

5.5.4.2 SDR/FRA entry and exit points will be published in the AIP, with a clear reference to the SDR/FRA and the nature of the point (entry, exit or entry/exit point).

NOTE: The publication of extended SID/STAR procedures or the connection of ATS routes are also operationally-recommended options.

5.5.4.3 In the case of FRA, in order to benefit from the best operational conditions, airspace users may use any unpublished waypoint for flight planning defined by geographical coordinates. But this possibility must be clearly disclosed in the AIP. In cases where it is not possible to use coordinates, the publication of FRA reference points must be arranged.

5.5.4.4 Flight plan completion limitations must be published for areas where FRA is structurally limited, that is, where only limited combinations of entry and exit points are permitted.

5.5.4.5 Whenever a fixed ATS route network is maintained within the FRA, details will be provided in the aeronautical information products.

5.5.5 In the FRA and, exceptionally, in SDR airspace with low volume/complexity, airspace users may use any significant point, published or unpublished, defined by geographic coordinates, to indicate changes in cruising FL.

5.6 Flexible use of airspace (FUA)*

5.6.1 Aviation covers a wide range of users, from commercial aviation to military and recreational operations, each with its own mission or business objectives.

5.6.2 Flexible use of airspace (FUA), defined as element **FRTO-B0/2** in the GANP, is an airspace management concept based on the principle of accommodating all airspace users inasmuch as possible, considering effective communication, cooperation, and the necessary coordination to ensure safety, efficiency and environmental sustainability.

5.6.3 The application of the FUA concept is intrinsically linked to FRTO, as the effective sharing of airspace and its efficient use by civil and military users through the harmonisation of strategic planning, pre-tactical allocation of airspace and its tactical use, create an environment conducive to FRTO implementation.

5.6.4 The implementation group (SAMIG) developed a "Guidance for the Implementation of the Flexible Use of Airspace (FUA) Concept in the South American Region", which considers the SAM airspace as a single resource shared by all airspace users, with diverse and sometimes conflicting interests and requirements, which must be taken into account and addressed as far as possible.

5.6.5 Where required by the operational scenario, standard arrival and departure procedures, and 'non-permanent' or conditional routes will be implemented for a more efficient use of airspace.

**Note. - The Guide proposes to consider it as an enabler of FRTO implementation.*

5.7 Air traffic flow management (ATFM)

5.7.1 Air traffic flow management (ATFM) is a system and a set of procedures aimed at managing and optimising air traffic flow, especially at times of high demand or when events occur that may affect normal airspace capacity.

5.7.2 ATFM is implemented to avoid congestion, minimise delays and optimise the use of airspace and airports. It is often used in situations such as adverse weather conditions, unexpected events or during busy periods, such as holidays.

5.7.3 This management is carried out by air traffic control authorities and involves constant monitoring of traffic, demand forecasting, implementation of measures to adjust flight schedules, and coordination with airlines and other stakeholders to maintain the operational efficiency of the air traffic system. The objective is to ensure the safety, efficiency and smooth flow of air traffic in times of capacity-demand imbalances.

5.7.4 Depending on the way FRTO is implemented, it is possible that airspace capacity will be reduced, mainly if there is no proper sectorisation, there are gaps in ATS surveillance, and the necessary ATM tools are not available. This possible reduction in capacity is closely related to the complexity and volume of air traffic. When planning FRTO implementation, the available ATC capacity and airspace complexity must be taken into account so that the benefits that can be obtained from such implementation are not lost by routine adoption of ATFM measures. However, consideration must be given to possible ATFM measures to be adopted on a non-routine basis when planning the establishment of UPR or DCT routes and also FRA.

5.8 PBN and PBCS certification of air operators

5.8.1 Performance-based navigation (PBN) and performance-based communication and surveillance (PBCS) are concepts related to the modernisation and standardisation of aviation navigation, communication and surveillance systems. Both are key to improving operational efficiency, reducing airspace complexity and increasing air traffic system capacity.

5.8.2 PBN certification is a process by which aircraft and navigation procedures are assessed and certified based on their performance. Rather than relying on ground infrastructure, PBN uses on-board systems, such as the global positioning system (GPS), to determine aircraft position and trajectory. PBN certification enables the implementation of more flexible navigation procedures, such as area navigation (RNAV) and required navigation performance (RNP), improving the efficiency of air operations.

5.8.3 PBCS certification relates to aircraft communication and surveillance performance for application in oceanic airspace. It sets performance standards for communication systems, such as satellite communications (for example, controller-pilot data link communications - CPDLC), and for surveillance systems, such as automatic dependent surveillance-contract (ADS-C). PBCS certification is essential to ensure that aircraft meet the performance requirements for operation in specific areas of airspace, especially on long-haul routes or in oceanic regions, where operational benefits are expected and air traffic complexity/volume warrant it.

5.8.4 PBCS certification is not essential for the successful implementation of FRTO concepts and for most of the oceanic airspaces of the Region, with the exception of the EUR/SAM corridor in the South Atlantic.

5.8.5 It is expected that, given the post-COVID scenario, the older and more inefficient fleet will be withdrawn from service and users lacking PBN/PBCS certification will be significantly reduced. The benefits derived from the operational concept are based on the modern navigation capabilities of most of the commercial air fleet operating in the Region.

5.9 Human factors and training

5.9.1 As progress is made towards the Global ATM operational concept and the development of the GANP, an increasing level of automation will be required. However, the human being will at all times continue managing automation. In basic terms, this means that humans will decide what is to be done, will delegate the execution of tasks to automation, and will be able to intervene when necessary.

5.9.2 People with the appropriate skills and competencies, properly certified and trained, will continue to be the pillars of ATM/CNS operation and support services. With the expected recovery and growth of aviation, it is critically important to have sufficiently qualified and competent personnel to ensure a safe and efficient aviation system.

5.9.3 States must incorporate human performance in the planning and implementation phases of new systems and technologies within the framework of the GANP and the regional and national plans. Early involvement of operational staff is also essential.

5.9.4 In relation to the above, it is necessary to emphasise the importance of incorporating human performance in the programmes and courses taught in the aeronautical training centres in the States of the Region. The training of aeronautical personnel is fundamental for the purposes of this document.

5.9.5 Each airspace has its own challenges and complexities. Accordingly, properly planned training is required, based on the agreed roadmap and activities and, where possible, using simulators to recreate scenarios as close as possible to working environments, with dynamic situations that contemplate possible contingencies.

5.9.6 Furthermore, ATC sector capacity studies should be conducted based on the analysis of ATCO´s workload, which may lead to the identification of improvements in the static and dynamic sectorisation of the ACC. Within this context, possible ATC staff limitations that could affect implementation (for example, by constraining training activities) should be addressed.

5.9.7 The implementation of FRTO is not expected to increase ATCO's workload. However, it will be very important to reinforce operational oversight at ACCs. Likewise, the SMS of ATC units shall adopt the new FRTO operational framework in its processes and manuals.

5.9.8 The training needs of crew, airline flight dispatchers, AIS, MET and CNS personnel, as well as subject matter experts concerned with FRTO implementation, must be identified and addressed.

6 IMPLEMENTATION ISSUES

6.1 Performance measurement. Application of KPIs and data management

Note.- See tables in Appendix B.

6.1.1 The GANP sets forth 24 key performance indicators, as shown in the following link:

https://www4.icao.int/ganpportal/ASBU/KPI

6.1.2 In each of the 24 formats presented, the following KPI components are explained:

- Definition
- Measurement units
- Operations to be measured
- KPI variants
- Characterised objects
- Usefulness of the KPI
- Parameters
- Data requirements
- Data providers
- Formula/algorithm

6.1.3 It is noted that the management of KPIs and their use to measure the extent to which the expected performance has been achieved as part of the enhancement for the ASBU element requires collaborative action by various actors in the system, such as airports, ATFM services, ANS providers, airlines, itinerary databases, ADS-B providers, etc.

FOQA and Big data

6.1.4 Data available at airline level, such as flight distance/time and fuel consumption, as well as trajectories actually flown before and after FRTO implementation, can be used for the design of procedures, routes and mainly for post-implementation assessment of an optimised airspace concept because it provides real information on the benefits obtained from implementation.

6.1.5 The information provided by the Big Data Project on air traffic movement is a valuable input for airspace planning tasks. This information is derived from the analysis of data provided by aircraft ADS equipment and transmitted to a network of receivers on the ground and then analysed to produce safety or statistical indicators that can be used for measurement and airspace planning. The information can be updated every three hours, providing constant, accurate and low-cost information.

6.1.6 In the FRTO operational concept, airspace planning involves the use of several key indicators to ensure an efficient and safe operation. These indicators are designed to assess the effectiveness of FRTO planning and implementation. Some indicators/metrics that may be developed and applied are listed below:

a) Route efficiency: Assesses the efficiency of planned routes compared to traditional routes. It can be measured by flight distance and flight time compared to historical routes.

b) Airspace utilisation: Measures how efficiently airspace is used in the free-route area, considering the flexibility provided by the FRTO concept.

c) Reduction of flight distance and flight time: Assesses the reduction in flight distance and flight time as a result of more direct and efficient route planning.

d) Flight plan compliance: Analyses how well aircraft follow their flight plans, ensuring compliance with planned routes.

e) Congestion reduction: Measures the reduction of airspace congestion due to the implementation of more flexible and direct routes.

f) Runway and airport usage optimisation: Evaluates the efficiency of runway allocation and airport management, since FRTO may have an impact on arrival and departure distribution.

g) Safety: Considers safety indicators, such as the rate of compliance with altitudes and separation procedures, to ensure that FRTO implementation does not compromise safety.

h) Fuel consumption reduction: Evaluates the reduction in fuel consumption due to more efficient routes and reduced flight times.

i) User satisfaction (airlines and passengers): Measures airline and passenger satisfaction with respect to route flexibility, punctuality and overall efficiency of operations.

j) Improved airspace capacity: Evaluates how FRTO implementation contributes to improving airspace capacity, allowing for more operations.

6.1.7 These indicators/metrics are essential to measure the success and benefits of the FRTO concept, providing valuable information to continuously adjust and improve operations and airspace planning.

6.1.8 It is important to note that, during FRTO implementation, CO2 reduction data will be collected to the extent possible, although this is not a requirement for its implementation. This data may not be available from airlines or may be very difficult for States to obtain, depending on each reality. It is estimated that, by promoting improved airspace capacity and efficiency, there will be a natural reduction in CO_2 emissions from aviation.

6.1.9 Likewise, the information captured by Big Data can be used to determine aircraft movement flows for input into airspace design, which is very useful for noise segregation procedures or other purposes.

6.1.10 The aforementioned indicators are just some of those that will be available to users of the Big Data project to directly support airspace planning tasks.

6.2 Pre-operational analysis and airport accessibility

6.2.1 It should be noted that, within route optimisation, there are factors for airlines and air operators such as: aeronautical charges, routes in case of depressurisation (escape routes), distance to alternate aerodromes, weather conditions, etc., which may determine that the shortest distance between two points is not necessarily the optimum trajectory in a given circumstance. Implementation shall involve specific studies when these factors impact any area or segment of the FIR.

6.2.2 Consideration must also be given to the effect of publishing meteorological minima for alternate aerodromes that are higher than the published instrument approach procedure minima for the same aerodrome, in order to ensure airport accessibility.

6.3 Safety assessment

6.3.1 Safety must be guaranteed in any airspace design or procedure modification contemplated for its optimisation. This includes compliance with ICAO SARPs and relevant State regulations.

6.3.2 After airspace changes are made, the system should be monitored and operational data collected to ensure that safety is preserved, to determine whether strategic objectives have been achieved, and to identify opportunities for improvement.

6.3.3 **Appendix D** presents a safety assessment model developed for SDR implementation in the SAM Region.

6.4 Project communications plan

TBD

6.5 Cost-benefit analysis

6.5.1 States in the Regions should conduct a cost-benefit analysis of airspace modifications and of planned infrastructure and modernisation investments. In the AN-SPA tool and in the fourth layer of the NANP, GANP/6 presents some basic considerations and a checklist for conducting this analysis (CBA checklist).

6.6 Air navigation – System performance assessment (AN-SPA)

6.6.1 To support air navigation planners, the GANP portal has included--in the second layer, "Global technical"--an air navigation system performance assessment tool. The objective of this tool is to promote a performance-based approach to cost-effective modernisation of the air navigation system. This tool is presented in the form of a "survey" and guides the aviation community in the application of a six-step performance management process and in the selection of relevant operational improvements within the ASBU framework.

6.6.2 It is strongly recommended to conduct several trials, for one or more of the KPAs involved. In the case of FRTO, it will be very illustrative to conduct an exercise for a continental airspace scenario in the CAR/SAM Regions. Similarly, operational scenarios in TMAs and aerodromes can be assessed.

6.6.3 Collaborative decision-making is key to a cost-effective modernisation of the air navigation system and, therefore, all relevant aviation stakeholders must be involved. The link is shown below. The user must first register (log in in the top right corner of the portal). A personal email address can be used:

https://www4.icao.int/ganpportal/ANSPA/Reports

7 PLANNING PRINCIPLES

7.1.1 It is essential to set clear objectives for FRTO implementation, such as reducing flight times, saving fuel, increasing airspace capacity or improving operational efficiency. Regulations, coordination mechanisms and pre-existing CNS infrastructure must be taken into account, together with airspace structure, complexity and capacity, as well as meteorological characteristics and, if necessary, ATFM requirements.

7.1.2 FRTO involves coordination and collaboration amongst various stakeholders, including civil aviation authorities, air navigation service providers, airlines and airport operators, from the outset of the implementation project. Integrated planning is essential to ensure that all aspects of FRTO implementation are effectively considered and coordinated.

7.1.3 Relevant stakeholders must be involved from the beginning of the FRTO implementation process. This includes listening to the concerns and perspectives of airlines, air traffic controllers, airport operators and other stakeholders, thus ensuring a more collaborative and inclusive implementation process.

7.1.4 Successful implementation of FRTO requires adequate capacity-building and training for all parties involved. This may include training air traffic controllers on new procedures and tools, training pilots on how to operate on flexible routes, and training flight planning teams on the use of trajectory optimisation tools.

7.1.5 FRTO implementation must take place throughout the CAR/SAM Regions. Given the size of the airspace and the specificity of each State, implementation must start in scenarios with low complexity and/or better ATM/CNS infrastructure, and evolve to create blocks of homogeneous areas in which the concept is applied.

7.1.6 FRTO must be applied in airspace with a defined lower limit, and not affect adjacent areas where it is not yet being fully applied. Climb and descent profiles in the underlying areas must be taken into account for the establishment of transition points to provide a structured transition, which will not necessarily be at the FIR boundary and which will preferably be aligned with the ATS fixed route network.

7.1.7 It is recommended that the reconfiguration of airspace reservations and restrictions be coordinated with the respective responsible parties. Likewise, studies must be conducted to review sectorisation, if needed, in order to harmonise the FRTO implementation area and ensure capacity-demand balancing in the respective sectors.

The criteria for defining ATC sectors will take into account, at least:

a) the main traffic flows and directions;

b) avoiding short crossings through ATC sectors;

c) avoiding re-entry into the sector or FIR;

d) location and activation modes of airspace reservations and restrictions; and

e) consistency with adjacent ATS fixed route sectors and connection of ATS routes to SID/STAR procedures.

7.1.8 Prior to FRTO implementation, it is important to conduct a thorough assessment of potential risks and impacts associated with the change. This may include safety, air traffic impact, system interoperability, regulatory compliance and environmental impact assessments.

7.1.9 After FRTO implementation, it is important to continuously monitor system performance and assess whether planned objectives are being achieved. This may involve collecting and analysing operational data, feedback from stakeholders, and conducting periodic reviews to identify areas for improvement and opportunities for optimisation.

8 PROJECT RISKS

Note. - This section presents an initial identification of project risks. In a later version of this Guide, GESEA SG1 shall validate them and develop a matrix proposing a mitigation action for each risk, and applying a risk rating of 8-10 for highest risk, 6-7 for medium risk, 1-5 for low risk.

Airspace optimisation based on the FRTO concept may entail several risks, challenges and interdependencies. It is crucial to identify and manage them to ensure successful implementation. The following are some potential risks associated with this project:

a) Regulatory resistance: There may be resistance or challenges from civil aviation authorities when significant airspace changes are introduced. Therefore, proactive engagement with regulators, transparent communication, and collaboration in the planning and implementation phases will be required.

b) Operational resistance: The implementation of new systems and procedures to support FRTO may face resistance from technicians and operators. Therefore, it will be necessary to conduct simulations, involve experts in the process, and conduct a gradual implementation to minimise impacts.

c) Technological challenges: There may be technical problems, such as CNS system failures, as well as failures in the integration of ATM systems between States. Therefore, there is a need for a back-up system, rigorous testing, and close cooperation with technology providers, as well as dialogue and collaboration with aviation authorities in other countries to harmonise standards and procedures.

d) Adoption by industry: Resistance or lack of certainty on the part of airlines in adopting new FRTO routes and procedures. There must be active engagement with airlines, demonstration of benefits, and incentives for adoption.

e) Insufficient training: Lack of adequate training for pilots, air traffic controllers and other professionals involved in new FRTO practices. Comprehensive training programmes, periodic training sessions and educational materials must be developed.

f) Safety: The introduction of new routes and procedures may affect control capacity, aircraft separation, and/or ATCO workload. Therefore, there must be a pre-implementation risk analysis, constant safety monitoring, and immediate adjustments in case of problems.

g) Impact on existing operations: Significant changes can adversely affect existing operations, resulting in delays and disruptions. Therefore, careful planning, effective communication with stakeholders and phased implementation must take place to minimise disruption.

h) Weather challenges: Adverse weather conditions may affect FRTO efficiency, especially in the case of more direct trajectories, such as SDR. Therefore, contingency protocols, weather monitoring and real-time route updates must be applied.

i) Communication failures: Failures in internal and external communication can lead to misunderstandings and resistance. Therefore, there must be clear communication channels, regular updates and active engagement with all stakeholders.

j) Lack of CNS infrastructure: Lack of communication and/or surveillance coverage may affect the safety of air operations. Likewise, lack of the required navigation certification is an obstacle to FRTO implementation. Therefore, States and airlines must establish procedures and means to prevent this situation, as FRTO implementation will quickly benefit them.

k) Lack of financial resources: Lack of resources can hinder or even prevent FRTO implementation. Both States and airlines must strive to allocate resources for system development and personnel training.

l) Lack of human resources: Pilots and air traffic controllers are professionals who require very specific qualifications, which involves time for training and skills development. While it is not a specific item of this project, although automation is increasingly taking place in the airline industry, there is a need for States to manage personnel to support the growing demand from the airline industry.

m) Lack of airport infrastructure: Statistics show that the number of aircraft operations will soon exceed the number of aircraft movements prior to the COVID-19 pandemic. Therefore, investments in airport infrastructure will be necessary so that this does not create a domino effect on airspace management and jeopardise FRTO implementation.

n) Implementation delays: Difficulties in executing changes as planned can lead to delays in implementation. There is a need for constant monitoring of progress, proactive identification of obstacles, and timetable adjustments as appropriate.

IMPLEMENTATION SOLUTIONS AND ELEMENTS

9 PRE-VALIDATED AND COORDINATED ATS ROUTES TO SUPPORT FLIGHT AND FLOW (FRTO-B0/3)

This element consists of a collection of routes that have been pre-validated and coordinated with ACCs and airspace users concerned. There are three main options for these routes: preferred routes, Playbook routes and coded departure routes (CDRs).

According to the GANP definition, there are many cases where ATC needs to *move air traffic away from or closer* to a particular area of airspace. When this happens, the ATS usually implements diversions, a common route, or a set of routes, that they want aircraft to use in a particular area.

These routes are predetermined and apply to a given sector/airport accordingly. The routes are available through the ANSP database and are published in appropriate media (AIP, AIC, websites, etc.) for access by airspace users.

- Preferred routes are the normal, everyday routes that ATC wants operators to submit. These routes were developed to increase system efficiency and capacity by having balanced traffic flows between high-density airports, and to eliminate conflicting traffic flows where possible. Preferred routes are those that operators normally submit.

- Playbook routes are a set of standard routes that ATC can use to adapt to a particular set of circumstances, when preferred routes are not available. These routes were created to allow for fast implementation when so required.

- CDRs are a combination of coded air traffic routes and refined coordination procedures designed to reduce the amount of information to be exchanged between ATC and flight crews.

Operational and dependent relationship with other ASBU elements:

  - FRTO-B0/1 – Direct routing (DCT)
  - FRTO-B0/2 – Airspace planning and flexible use of airspace
  - AMET-B0/1 – Meteorological observation products
  - AMET-B0/2 – Meteorological forecast and warning products
  - AMET-B0/3 – Dissemination of meteorological products

NOTE

By way of reference, the following paragraphs 9.1, 9.2 and 9.3 describe **enhanced route** applications being implemented in the Region, even as part of trans-regional FRTO trials within CIIFRA. Some differences or variations with respect to the GANP text are identified. GESEA will further study this issue to define the most appropriate alignment with the GANP, recognising regional needs.

9.1 User-preferred routes (UPR)

9.1.1 User-preferred routes (UPRs) are routes requested by airlines that optimise routing between a specific city pair. UPRs must be approved by all ANSPs, through their flow management units, area control centre managers, or civil aviation authorities, as appropriate, affected by any segment of the route. The UPR may be approved for a trial period, if necessary.

9.1.2 Once a UPR is approved for testing, it will be available for a specific period (that is, for a trial period) and for a specific airline. The purpose of route trials is to determine the operational viability of routes. Once the operational viability of the route has been verified, whether or not a trial period is required, it will be published in accordance with the standards and procedures set out in the AIP of each State involved. Upon publication of the route segments by the States, all airlines will be able to use these segments for any city pair until further notice.

9.1.3 The CANSO-IATA-ICAO Free Route Airspace (CIIFRA) team developed a UPR catalogue, containing airline proposals, which are being coordinated with ANSPs in order to start a trial period, if necessary, and then proceed to their full implementation. The publication of UPRs in the route catalogue and other proposals to be made by airlines have the potential to significantly increase savings and contribute to the evolution towards strategic direct routing (SDR) and free-route airspace (FRA).

9.1.4 By nature, UPRs are flexible, and "conventional" publications such as the AIC, AIP supplement or AIP amendment may not be flexible enough to provide a good quality of service to airlines, and to assure ANSPs that the routes being flown are exactly what they expect and are prepared for. In this regard, the best way to provide information to both pilots and ATCOs and, at the same time, give the necessary flexibility to ANSPs to implement and cancel UPRs without a complicated aeronautical publication process, is to make a generic publication of UPRs in the AIP, in the ENR section, and include a link to the ANSP website where UPRs can be found. If the ANSP does not have a website or if there is no way of publishing UPRs on the ANSP website, a link to a specific Excel file or other more suitable format can be used.

Note. – By way of reference, Brazil´s AIP includes the definition of UPR route in section ENR 3.3 - Other routes.

9.1.5 For airspace users, it is important to get a complete picture of the entire UPR, especially those involving several ANSPs. Thus, it is highly recommended that a complete route catalogue be published on the ICAO SAM Office website or on the future SAM Portal with inter-regional projection.

9.1.6 A model for UPR publication in the AIP is shown in **Appendix E.**

9.1.7 For the implementation of the UPRs proposed by airlines, it is important that States keep their contact points up to date and that they are capable to give a quick response to such proposals.

9.1.8 Efficiency of analysis and implementation is expected to be achieved through the use of an electronic tool that connects airlines, the State/ANSP experts responsible for analysis and the sector responsible for publication, such as, for example, Brazil's Digital Airspace System Analysis (DASA) tool. It is important to note that the point of contact will also be necessary with the use of the electronic tool, because it will require that States/ANSPs designate those responsible for analysis and publication.

9.2 Playbook routes

9.2.1 Playbook routes are a set of standard routes that the ATC can use to adapt to a specific set of circumstances when preferred routes are not available. These routes are designed for rapid deployment as needed and provide standard guidelines and procedures for all stages of the routing process, contributing to an efficient and coordinated operation.

9.3 Coded departure routes (CDR)

9.3.1 CDRs are a combination of coded air traffic routes and detailed coordination procedures designed to reduce the amount of information to be exchanged between the ATC and flight crews. They are routes that overfly airspace with low potential for temporary reserved use (TRA or TSA) in order to conduct specific activities or that meet specific ATC conditions, such as air traffic restrictions or sectorisation.

9.3.2 CDRs are generally established and used as part of pre-planned rerouting scenarios, allowing for the definition of more direct and alternate routes.

9.3.3 CDRs are divided into three categories:

a) CDR1 – category applicable to those routes that may be included in the flight plan at any time or at specific periods of time:

- they are defined in the airspace planning phase and the impact of potential disruptions of a CDR1 must also be assessed and managed at the pre-tactical level, just like the availability of CDR2;
- in case a CDR1 is not available at the pre-tactical level, operators must consider the implications of a possible rerouting and the use of alternate routes published for each CDR1;
- in case of unavailability of a CDR1 at the tactical level, ACCs must provide diversions to users; and
- interruptions must be published via NOTAM.

b) CDR2 – category applicable to those routes that can only be included in the flight plan under certain conditions:

- they are defined in the airspace planning phase with the objective of pre-establishing route changes to better distribute traffic; and
- a CDR2 can only be used when it is available after analysing the AMC at the tactical level.

c) CDR3 – category applicable to those routes that cannot be included in the flight plan, but that may be used by the ACC at the tactical level.

- availability is defined at the tactical level; and
- following coordination with the concession holder responsible for the associated TRA, TSA, R or D area, the controller may offer an aircraft a CDR3 through the area.

10 DIRECT ROUTING (FRTO-B0/1)

10.1 SDR allows users to plan a route using any designated fix within a specific airspace volume provided the route meets the parameters set by the State. Parameters may include restrictions, such as periods during which SDR rules apply, altitude requirements above or below a reference value, and the maximum distance between fixes. Users must submit flights along authorised (that is, published) routes to the point of entry/exit at the boundary of the SDR airspace volume. That is, the SDR system only applies within the defined airspace volume. SDR is a transition to the implementation of the free-route airspace (FRA) concept.

10.2 The implementation of strategic direct routing (SDR) must be based on the Global Air Navigation Plan - ASBU FRTO B0/1, so as to give airspace users additional flight planning options, with larger-scale routing options in all FIRs, so that planned distances can be reduced overall, compared to the fixed route network. SDR must be established at national and regional level and be available for flight planning (with published conditions of use). SDR allows airspace users to optimise flight and fuel use planning.

10.3 If necessary, SDR could be applied in a limited manner, for example:

- Time restriction (fixed or subject to traffic/availability);
- Traffic restriction (based on traffic flow and/or level);
- Flight level;
- Lateral restrictions; and

- Entry/exit points.

10.4 The following procedures and processes may need to be considered:

- Identify the volume of SDR airspace (lateral and vertical) and the applicable schedule;
- Direct routes can coexist with the ATS route structure;
- Adapt airspace design to ensure horizontal and vertical connectivity with SDR;
- ATFM procedures for SDR;
- Review LoAs with adjacent ATS units;
- Publish SDR-relevant data in the AIP;
- Airspace management procedure for the implementation of direct routes; and
- ATC procedures for SDR coordination, including transfer, direct routing path changes, conflict detection, etc.

10.5 Operational and dependent relationship with other ASBU elements:

- NOPS-B0/1- Initial integration of collaborative airspace management with air traffic flow management – Integration of airspace management with air traffic flow management is a desirable requirement, with a view to optimising SDR implementation.
- FRTO-B0/2 – Airspace planning and flexible use of airspace: FUA implementation could optimise SDR implementation, considering that DCT routes could enter special-use airspace in accordance with pre-established procedures.
- FRTO-B0/4 – Basic conflict detection and conformance monitoring: Medium-term conflict detection (MTCD) and conformance monitoring tools are considered as requirements to reduce the workload of air traffic controllers in high-volume air traffic environments. Consequently, they can be considered as desirable requirements and must be taken into account when upgrading ATM systems.
- FICE-B0/1 – Automated basic inter-facility data exchange: AIDC is considered to be a desirable tool for SDR implementation, with a view to reducing ATCO workload, especially in high-volume air traffic operational environments, particularly when there is transfer of SDR flights in both FIRs.

10.6 Regarding enablers, FRTO BO/1 of the Global Air Navigation Plan lists a number of EUROCONTROL documents that could be used as guidance material. However, it should be noted that SDR implementation in the CAR/SAM Regions considers airspace characteristics and a significantly lower level of air traffic demand compared to Europe.

10.7 It is expected that SDR will be initially implemented on a State-by-State basis, within the boundaries of their airspaces, using the published boundary fix as the entry/exit point from one SDR system to the next, based on specific rules established by each State. However, an evolution towards cross-border SDR is also expected, based on harmonised regulations and standard procedures in the CAR/SAM Regions. This will allow for even greater efficiency by using more fixes at FIR boundaries and making more direct routing options available. A specific goal in starting cross-border SDR in the CAR/SAM regions is to use SDR airspace already implemented to encourage adjacent FIRs to join SDR implementation in a harmonised manner.

10.8 SDR implementation started in Brazil in the Amazonica and Recife flight information regions (FIRs), on 16 April 2020, during the COVID-19 pandemic, considering the significant decrease in flight demand.

10.9 Similarly, in the South American Implementation Group (SAM/IG), States started implementation in several FIRs of South American States (Brazil, Chile, Ecuador, Guyana, Peru, Colombia*, Suriname and Venezuela), using procedures published through AIP amendment or AIP SUP, based on an aeronautical publication model developed by the South American Airspace Study and Implementation Group (GESEA).

> ** Note.- Colombia implemented SDR in 2020, in accordance with the initiative promoted by SAM/IG. Subsequently, with the recovery of air operations in 2021, priority was given to routing for arrivals at the Bogota international airport.*

10.11 The active involvement of States, air navigation service providers, and airlines is essential for the implementation of strategic direct routing as an initial step to meet the goal of implementing free-route airspace (FRA). It is important to note that strategic direct routing is the most appropriate way to move towards FRA, in accordance with the Global Air Navigation Plan (GANP), and its implementation by some States in the Region has already demonstrated its feasibility and corresponding benefits.

10.12 A model for SDR publication in the AIP is shown in **Appendix F**. It is advisable that States using UPR and SDR reach consensus on the publication of standards and procedures, by defining a particular location in the AIP section*, in order to make it easier for each State to understand airspace management.

**Note: The most appropriate AIP section shall be defined by consensus.*

11 FREE-ROUTE AIRSPACE (FRTO-B1/1)

11.1 FRA is a specific volume of airspace within which users may freely plan a route between a defined point of entry and a defined point of exit, with the possibility of routing through intermediate points (published or unpublished), without reference to the ATS route network, subject to airspace availability. Within this airspace, flights remain subject to air traffic control. FRA allows airspace users to fly as close as possible to what they consider to be the optimum path, without the constraints of a fixed route network structure.

11.2 FRA implementation can be customised, for example:

- horizontally and vertically;
- during specific periods;
- with a set of entry/exit conditions;
- with initial system updates.

11.3 The extension of FRA within and across FIR boundaries also requires improvements to the ATM network function system and the ground system of air navigation service providers for purposes of airspace management and flight data processing.

11.4 The following procedures and processes are expected to be taken into account:

- FRA airspace volume (lateral and vertical) and applicable time (H24 7/7 is not necessary);
- FRA entry and exit points, arrival and departure transition points, and intermediate points;

- adapting airspace design and ensuring horizontal and vertical connectivity of FRA;
- ATFM procedures in FRA;
- adapting LoAs with adjacent ATS and military units;
- publishing FRA-relevant data in the AIP;
- aeronautical charts for FRA operations;
- airspace management procedure for the implementation of free-route operations;
- ATC procedures for free-route coordination and transfer of control, change of trajectory in a free-route environment, conflict detection.

11.5 Improvements to ATM systems for flight data processing and controller work position, if needed, are related to:

- ATC clearances beyond their area of responsibility (AoR);
- distinction between different types of traffic;
- 4D trajectory calculation using aircraft operational information (AoI);
- editing function for 4D trajectories;
- management of coordination points for FRA;
- coordination with military bodies;
- improving conflict management and HMI functions of the controller to support conflict detection and resolution.

<u>11.6 Operational and dependent relationship with other ASBU elements:</u>

- NOPS-B1/5 – Full integration of airspace management with air traffic flow management. it is desirable for FRA to ensure a continuous, seamless and iterative approach to airspace and air traffic flow management based on airspace requests at any time during the strategic, pre-tactical and tactical stages of ASM.
- FRTO-B1/4 – Dynamic sectorisation. It is recommended to dynamically adapt ATC sectorisation to respond to traffic demand without increasing the number of controllers/work positions being used for FRA. The sectorisation function will allow for dynamic management of a large number of possible sector configurations, where the automated system is continuously assessing future traffic demand and complexity and proposing optimal sectorisation solutions.
- FRTO-B1/3 – Advanced flexible use of airspace (FUA) and management of real-time airspace data. FUA procedures must be enhanced by ASM data sharing between the ATM network function, ASM actors, airspace users and ATC. ASM data regarding the planning and tactical management of airspace reservations need to be continuously exchanged and integrated in real time between the ATM systems. Continuous exchange of ASM data between civil and military national actors will be enhanced. Automated ASM systems to ensure uninterrupted data flow between ATM Network functions and the neighbouring ASM systems from the pre-tactical planning to the real time airspace status are needed
- FICE-B0/1 – Automated basic inter-facility data exchange (AIDC). For FRA, it is necessary to improve the effectiveness of coordination and transfer of control between ATS units to ensure that all related and required flight information will be available to the other unit as agreed.

- FRTO-B1/5 – Enhanced conflict detection tools and conformance monitoring. Improvements need to be made to the basic medium-term conflict detection (MTCD)/monitoring alert (MONA) functions to further improve ATCO productivity and reduce the workload for FRA.
- DAIM-B2/2 – Daily airspace management information to support flight and flow. It is essential to establish common practices and data formats for daily airspace management initiatives that are continuously updated as events occur, for the planning and execution of flights and flows in FRA. Information related to the status of airspace configuration (corrections, FIR boundaries, static zones, etc.) and on airspace evolution (rerouting, sector configurations, airspace usage plan and updated airspace usage plan, airspace reservations, restrictions and route availability, dynamic zones, etc.) will be available in formats compatible with NOPS and FICE automation.
- FRTO-B0/1 – Direct routing (DCT). Direct routes are established with the purpose of providing airspace users with additional flight route planning options on a larger scale, across FIRs, so that total planned segment distances are reduced compared to the fixed route network. SDR is a transition to the implementation of the free-route airspace (FRA) concept.

11.7 Specific performance indicators need to be developed for FRA in order to quantify the variation in ATC workload, sector capacity and the increase in potential traffic conflicts, which will be re-assessed on a seasonal basis.

11.8 Similarly, with SDR, FRA is expected to be implemented first within State boundaries, using their specific procedures and limitations, evolving to cross-border FRA, as provided for the medium term in ASBU FRTO B2/3 – Large-Scale Cross-Border Free-Route Airspace.

12 RNP ROUTES (FRTO-B1/2)

Note. - This solution requires further studies to define the implementation of RNP routes in defined areas of the SAM Region. Progress has been made in Chile with RNP-2. The following paragraphs include a description extracted from the GANP.

12.1 RNP routes must be deployed in en-route airspace where free-route airspace (FRA) is not planned or, if FRA is deployed, RNP routes must ensure connectivity between FRA and the TMA.

12.2 The aim is to provide consistent navigation using the most appropriate PBN type, infrastructure and navigation applications.

12.3 Performance-based navigation (PBN) specifications allow aircraft to fly a specific path between two 3D-defined points in space. The new capability refers to the implementation of PBN/RNP routes within en-route airspace. The FRTO-B1/2 element is described as follows:

- With the introduction of an RNP navigation specification, the benefits gained from RNAV will be enhanced by on-board performance monitoring and alerts and a more predictable aircraft behaviour.
- Optimised route design that may include closely-spaced parallel routes, fixed-radius transition (FRT), and en-route tactical parallel offset (TPO) functionality, supported by infrastructure and system enhancements to accept PBN routes.
- An adequate navigation infrastructure is required. GNSS or DME ground infrastructure must be optimised to support RNP operations and primary fallback capability in case of GNSS failure.

- PBN requires a complete digital chain, at critical data quality levels, for aeronautical data provided to airborne systems. System enhancements for controller support tools that may be required are covered by other FRTO elements (MTCD, MONA - monitoring aids) or other threads (SNET-safety nets).

13 FIVE-YEAR OBJECTIVES

Short term (2024 - 2025)

- Implement the UPRs of the route catalogue
- Create a process to expedite the publication of UPRs
- Develop regional guidance material for SDR and UPR implementation, including operational/technical requirements
- Develop a regional FRA CONOPS, including operational/technical requirements
- Start FRA testing in at least 1 CAR/SAM State

Medium term (2026-2028)

- Implement SDR in 80%+ of SAM FIRs
- Implement cross-border SDR in at least 4 adjacent SAM FIRs
- Implement FRA in 20%+ of CAR/SAM FIRs

It is important to note that the establishment of an FRTO implementation strategy for each SAM State is fundamental for the establishment of a CAR/SAM FRTO roadmap. This strategy will also enable the achievement of the aforementioned regional FRTO implementation targets.

APPENDICES

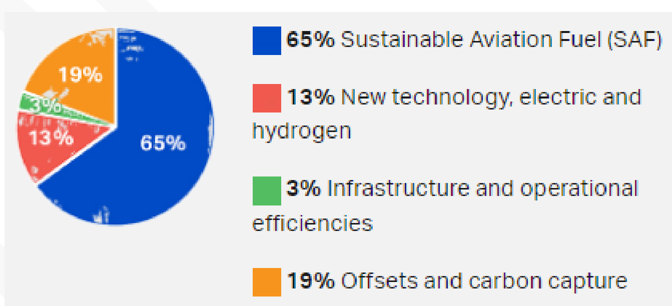
Appendix A. Sustainable aviation fuel (SAF)

Sustainable Aviation Fuel (SAF) is identified as one of the most important initiatives to reduce CO2 emissions from aviation. However, although technologies to produce these fuels already exist, they are produced in small quantities and production costs still need to be reduced. Large-scale production of SAF can mitigate environmental issues and alleviate social and economic problems in developing countries, as long as this production does not affect food security. On a conservative but optimistic view, about 5.7% of all arable land in 2050 will be available for biofuel production worldwide, which will be sufficient to supply about 92% of the estimated demand by 2100. However, to promote increased SAF production, it is necessary to promote its use and regulation through policies and legislation, and to have the financial and technical support from governments for the production and certification of these fuels.

At the 41st Assembly of the International Civil Aviation Organization (ICAO), the ICAO Council approved the feasibility of developing a long-term aspirational goal (LTAG) for international aviation to achieve zero net CO2 emissions by 2050. In the analysis, an assessment was made of the proposed targets, including the impact on national growth and the cost of implementation for States. This work helped to identify and assess existing, planned and innovative operational, technological and SAF utilisation measures for international air transport that could contribute to reduce CO2 emissions. Based on the collected information, ICAO experts created scenarios combining technological, operational and SAF utilisation measures in order to analyse the data and forecast future demand, considering the goal of increasing energy efficiency by 2% per year and increasing carbon neutrons from 2020 onwards. The experts will also estimate the cost and economic impact of the aforementioned measures on the growth of the air transport sector, especially for developing countries.

In the SAM Region, States have implemented some operational concepts and measures, including direct routing, which precedes the implementation of the FRA concept. These routes offer airspace users trajectory options during route planning that provide shorter distances compared to those of the fixed route structure.

Although it is estimated that "only" 3% of FLY NET ZERO will come from infrastructure and operational efficiencies (see figure below), it is important to note that all efforts are valid and necessary to achieve the proposed CO2 emission reduction goals. Moreover, in some airspaces, this percentage could be higher, which is significant for the operational efficiency of airlines and ANSPs.



There is a constant challenge to balance the growth of aviation with the need to mitigate its environmental impact. Continuous research and innovation are crucial to move towards a more sustainable aviation while promoting social well-being.

For more information, visit the following ICAO links:

https://www.icao.int/environmental-protection/pages/SAF.aspx

https://www.icao.int/environmental-protection/Pages/default.aspx

Appendix B. KPA module-focus area-KPI-FRTO element relationship

(FRTO Blocks 0 and 1 taken from the GANP portal; the Spanish version is a free translation)

* TBD = to be defined

KPA	Focus Areas	Most specific performance objective(s) supported	KPI	ASBU operational element	DESCRIPTION
					<<<
Efficiency	Flight time & distance	Overcome route selection inefficiencies associated with route network design	KPI04: Filed flight plan en-route extension	FRTO-B0/1	Direct routing (DCT)
Efficiency	Flight time & distance	Overcome route selection inefficiencies associated with route & airspace availability as known at the flight planning stage	KPI04: Filed flight plan en-route extension	FRTO-B0/2	Airspace planning and flexible use of airspace (FUA)
Efficiency	Flight time & distance	Reduce need to avoid airspace because of lack of confirmation that it will be open	KPI04: Filed flight plan en-route extension	FRTO-B0/2	Airspace planning and flexible use of airspace (FUA)
Efficiency	Flight time & distance	Facilitate direct routing of portions of the flight (if this does not cause network problems)	KPI05: Actual en-route extension	FRTO-B0/2	Airspace planning and flexible use of airspace (FUA)
Efficiency	Flight time & distance	Reduce need for tactical ATFM rerouting to circumnavigate airspace closed at short notice	KPI05: Actual en-route extension	FRTO-B0/2	Airspace planning and flexible use of airspace (FUA)
Efficiency	Vertical flight efficiency	Reduce altitude restrictions during climb to avoid Special Use Airspace	KPI17: Level-off during climb	FRTO-B0/2	Airspace planning and flexible use of airspace (FUA)

Efficiency	Vertical flight efficiency	Reduce altitude restrictions during cruise to avoid Special Use Airspace	KPI18: Level capping during cruise	FRTO-B0/2	Airspace planning and flexible use of airspace (FUA)
Efficiency	Vertical flight efficiency	Reduce altitude restrictions during cruise to avoid Special Use Airspace	KPI19: Level-off during descent	FRTO-B0/2	Airspace planning and flexible use of airspace (FUA)
Efficiency	Flight time & distance	Overcome route selection inefficiencies associated with route network design	KPI04: Filed flight plan en-route extension	FRTO-B1/1	Free-route airspace (FRA)
Efficiency	Flight time & distance	Overcome route selection inefficiencies associated with route & airspace availability as known at the flight planning stage	KPI04: Filed flight plan en-route extension	FRTO-B1/3	Advanced flexible use of airspace (FUA) and management of real-time airspace data
Efficiency	Flight time & distance	Reduce need to avoid airspace because of lack of confirmation that it will be open	KPI04: Filed flight plan en-route extension	FRTO-B1/3	Advanced flexible use of airspace (FUA) and management of real-time airspace data
Efficiency	Flight time & distance	Facilitate direct routing of portions of the flight (if this does not cause network problems)	KPI05: Actual en-route extension	FRTO-B1/3	Advanced flexible use of airspace (FUA) and management of real-time airspace data
Efficiency	Flight time & distance	Reduce need for tactical ATFM rerouting to circumnavigate airspace closed at short notice	KPI05: Actual en-route extension	FRTO-B1/3	Advanced flexible use of airspace (FUA) and management of real-time airspace data
Efficiency	Vertical flight efficiency	Reduce altitude restrictions during climb to avoid Special Use Airspace	KPI17: Level-off during climb	FRTO-B1/3	Advanced flexible use of airspace (FUA) and management of real-time airspace data

Efficiency	Vertical flight efficiency	Reduce altitude restrictions during cruise to avoid Special Use Airspace	KPI18: Level capping during cruise	FRTO-B1/3	Advanced flexible use of airspace (FUA) and management of real-time airspace data
Efficiency	Vertical flight efficiency	Reduce altitude restrictions during cruise to avoid Special Use Airspace	KPI19: Level-off during descent	FRTO-B1/3	Advanced flexible use of airspace (FUA) and management of real-time airspace data

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Capacity	Capacity shortfall & associated delay	Establish/update/publish the catalogue of strategic ATFM measures designed to respond to a variety of possible/typical/recurring events degrading the airspace system (e.g. predefined action plans)	TBD	FRTO-B0/3	Pre-validated and coordinated ATS routes to support flight and flow
Capacity	Capacity, throughput & utilisation	Reduce ATCO workload (en-route)	KPI06: En-route airspace capacity	FRTO-B0/4	Basic conflict detection and conformance monitoring
Capacity	Capacity, throughput & utilisation	Overcome capacity limitations attributable to route network design	KPI06: En-route airspace capacity	FRTO-B1/2	Required navigation performance (RNP) routes
Capacity	Capacity, throughput & utilisation	Take advantage of increased navigation precision (airspace with PBN operations) to implement route networks and airspace structures with smaller lateral and vertical safety buffers	KPI06: En-route airspace capacity	FRTO-B1/2	Required navigation performance (RNP) routes
Capacity	Capacity, throughput & utilisation	Improve flexibility of sector configuration management	TBD	FRTO-B1/4	Dynamic sectorisation
Capacity	Capacity, throughput & utilisation	Improve flexibility to modify sector configuration at short notice to cope with traffic pattern variations	TBD	FRTO-B1/4	Dynamic sectorisation

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Safety	TBD	Avoid vertical & lateral navigation errors during flight (cases of non-conformance with clearance)	**KPI20: Number of aircraft accidents**	FRTO-B0/4	Basic conflict detection and conformance monitoring
Safety	TBD	Improve early detection of conflicting ATC clearances (CATC) (en-route / departure / approach)	**KPI20: Number of aircraft accidents**	FRTO-B0/4	Basic conflict detection and conformance monitoring
Safety	TBD	Improve early detection of conflicting ATC clearances (CATC) (en-route / departure / approach)	**KPI23: Number of airprox/TCAS alert/loss of separation/near mid-air collisions/mid-air collisions (MAC)**	FRTO-B0/4	Basic conflict detection and conformance monitoring
Safety	TBD	Improve separation provision (at a planning horizon > 2 minutes)	**KPI20: Number of aircraft accidents**	FRTO-B0/4	Basic conflict detection and conformance monitoring
Safety	TBD	Improve separation provision (at a planning horizon > 2 minutes)	**KPI23: Number of airprox/TCAS alert/loss of separation/near mid-air collisions/mid-air collisions (MAC)**	FRTO-B0/4	Basic conflict detection and conformance monitoring
Safety	TBD	Improve early detection of conflicting ATC clearances (CATC) (en-route / departure / approach)	TBD	FRTO-B1/5	Enhanced conflict detection tools and conformance monitoring
Safety	TBD	Reduce number of vertical & lateral navigation errors during flight (cases of non-conformance with clearance)	TBD	FRTO-B1/5	Enhanced conflict detection tools and conformance monitoring

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Enviroment	Maintain or improve enviromental sustainibility of aviation	TBD	TBD	**FRTO (TBD)**	TBD

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Cost effectiveness	Improve cost-effectiveness of ANS	Reduce costs in the air navigation system	TBD	FRTO-B1/6	Multi-sector planning

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Access and equity	Improve access and equity	Improve airspace reservation management	TBD	FRTO-B0/2	Airspace planning and flexible use of airspace (FUA)
Access and equity	Improve access and equity	Improve airspace reservation management	TBD	FRTO-B1/3	Advanced flexible use of airspace (FUA) and management of real-time airspace data

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Flexibility	Improve flexibility of the air navigation system	Improve flexibility of the air navigation system	TBD	FRTO-B0/3	Pre-validated and coordinated ATS routes to support flight and flow

List of FRTO module elements, Blocks 0, 1

See original text at the ICAO GANP PORTAL:

https://www4.icao.int/ganpportal/

FRTO	**Improved operations through enhanced en-route trajectories**	**Operational**
FRTO-B0/1	Direct routing (DCT)	
FRTO-B0/2	Airspace planning and flexible use of airspace (FUA)	

FRTO-B0/3	Pre-validated and coordinated ATS routes to support flight and flow
FRTO-B0/4	Basic conflict detection and conformance monitoring
FRTO-B1/1	Free-route airspace (FRA)
FRTO-B1/2	Required navigation performance (RNP) routes
FRTO-B1/3	Advanced flexible use of airspace (FUA) and management of real-time airspace data
FRTO-B1/4	Dynamic sectorisation
FRTO-B1/5	Enhanced conflict detection tools and conformance monitoring
FRTO-B1/6	Multi-sector planning
FRTO-B1/7	Trajectory options set (TOS)

Appendix C. Appropriate infrastructure to support safe operations

Safety is a top priority for aviation. The Global Aviation Safety Plan (GASP) presents the global strategy for continuous improvement of aviation safety. The purpose of the GASP is to continuously reduce the number of fatalities and the risk of their occurrence, by seeking to guide the development of a harmonised safety strategy.

A safe, resilient and sustainable aviation system contributes to the economic development of States and their industries. The GASP promotes the effective implementation of a State safety programme, including a State safety oversight system, a risk-based approach to managing safety, and a coordinated approach to collaboration amongst States, regions (that is, a group of States and/or entities working together to strengthen safety within a geographic area) and industry. It provides a framework for the development and implementation of national and regional aviation safety plans (NASP and RASP).

The Global Aviation Safety Plan - GASP (Doc 10004) and the GANP are mutually supportive in recognising the need for appropriate infrastructure to support safe aircraft operations. Coordination of RASG-PA and GREPECAS activities is considered essential for the successful implementation of both global plans, as **increasing air navigation capacity and improving efficiency** must be done in a safe manner and appropriate safety nets are required to prevent accidents.

The basic building blocks (BBB) framework set forth in the second layer of the GANP, independently of the ASBU framework, describes the core structure of any robust air navigation system, defining the essential air navigation services to be provided for international civil aviation in accordance with ICAO SARPs and the Procedures for Air Navigation Services (PANS). These are essential services for aerodrome operations, air traffic management, search and rescue, meteorology, and aeronautical information.

BBBs do not represent an evolutionary step, but a reference defined by the basic services agreed by States under the Convention on International Civil Aviation to enable international civil aviation to develop in a safe and orderly manner.

The ASBU framework defines a set of operational improvements in certain areas of the air navigation system that the aviation community agreed to work on in order to maintain or improve the performance of the system (ASBU threads). An ASBU element is a specific change in operations aimed at improving the performance of the air navigation system under specific operational conditions.

In planning for improvements to air navigation systems, the following should be taken into account for the different stages of the pandemic:

a) risk assessment and prioritisation based on the data collected and analysed;

b) application of safety management principles for risk-based decision-making; and

c) management and oversight of approvals granted by CAAs, taking into account the flexibility required throughout the aviation system to continue operations under safe conditions.

Appendix D. Safety Assessment Model

EXAMPLE OF RISK ANALYSIS AND MANAGEMENT MATRIX APPLICABLE TO STRATEGIC DIRECT ROUTING (SDR)

Note: The following example of a matrix is considered valid for the period July-December 2020, with flight/overflight flow reduced to 10% - 40% of operations registered in December 2019, for the respective ACC.

(1) Flight phase or segment	(2) Hazard identification	(3) Possible consequences	(4) Risk index	(5) Mitigations	(6) Risk index after mitigation	(7) Notes
• **Oceanic** upper airspace • Aircraft transferred and under control and responsibility of the (sector) ACC	Data link failure affects CPDLC and simultaneous HF failure (or HF not available) on the aircraft prevent position reporting to ATC. Absence of aircraft position reports impairs ATC situational awareness.	This results in loss of separation between aircraft.	**3C Tolerable** **Remote: 3** **Major: C**	1. Flight plan management. Updated flight plan. ATS message. Doc 4444 Appendix 2. 2. ATS surveillance (ADS-C) available. 3. Procedures and methods on aircraft radio transmitter failure. Doc 4444, Ch 8 and Ch 15. 4. Procedures (and/or SUPPS) applicable to oceanic airspace, in case of communications failure. 5. Tables of levels, Annex 2, Appendix 3. 6. ACAS/TCAS on board. 7. Automated ATC systems with MTCD (medium-	**2D Acceptable** **Improbable: 2** **Minor: D**	The operational requirements for SDR implementation are shown in AIP SUP xx/20 of [State]

(1) Flight phase or segment	(2) Hazard identification	(3) Possible consequences	(4) Risk index	(5) Mitigations	(6) Risk index after mitigation	(7) Notes
				term conflict detection) and/or STCA (short-term conflict alert) 8. Communication via satellite phone.		
• **Continental** upper airspace • Aircraft transferred and under control and responsibility of the (sector) ACC	Aircraft radio transmitter failure prevents position reporting to ATC. Absence of aircraft position reports impairs ATCO situational awareness.	This results in a loss of separation between aircraft.	**3C Tolerable** **Remote: 3** **Major: C**	1. Flight plan management. Updated flight plan. ATS message. Doc 4444 Appendix 2. 2. ATS surveillance (radar or ADS-B) available. 3. Procedures and methods on aircraft radio transmitter failure. Doc 4444, Ch 8 and Ch 15. 4. Transponder code 7600 5. Tables of levels, Annex 2, Appendix 3. 6. ACAS/TCAS on board 7. Automated ATC systems with MTCD (medium-term conflict detection) and/or STCA (short-term conflict alert)	**2D Acceptable** **Improbable: 2** **Minor: D**	The operational requirements for SDR implementation are shown in AIP SUP xx/20 of [State]

(1) Flight phase or segment	**(2) Hazard identification**	**(3) Possible consequences**	**(4) Risk index**	**(5) Mitigations**	**(6) Risk index after mitigation**	**(7) Notes**
				8. The aircraft communications addressing and reporting system (ACARS) would allow the position to be received via the aircraft operator.		
• **Oceanic or continental** upper airspace • Aircraft transferred and under control and responsibility of the (sector) ACC	Severe communication failure in the responsible ACC prevents ATCO from receiving aircraft position reports. The absence of reports impairs ATCO situational awareness.	This results in a loss of separation between aircraft.	**3C Tolerable** **Remote: 3** **Major: C**	1. The State ATS contingency plan provides for the temporary suspension of SDR during a contingency.	**1E Acceptable** **Extremely Improbable: 1** **Negligible: E**	The operational requirements for SDR application are shown in the AIP SUP xx/20 of [State]
• **Oceanic or continental** upper airspace • Aircraft transferred and under control	Presence of bad weather conditions that require the pilot to ask to divert from the	This results in a loss of separation between aircraft.	**1C Acceptable** **Extremely Improbable: 1**	N/A	N/A	

(1) Flight phase or segment	(2) Hazard identification	(3) Possible consequences	(4) Risk index	(5) Mitigations	(6) Risk index after mitigation	(7) Notes
and responsibility of the (sector) ACC	planned route (path). The diversion authorised by ATC causes an overlap with the path of another aircraft.		**Major: C**			

Examples of tables and matrices for the analysis of risks and mitigations

Figure 1: Example of risk likelihood table

Probability	**Meaning**	**Value**
Frequent	— Likely to occur many times (has occurred frequently)	5
Occasional	— Likely to occur sometimes (has occurred infrequently)	4
Remote	— Unlikely to occur, but possible (has occurred rarely)	3
Improbable	— Very unlikely to occur (not known to have occurred)	2
Extremely improbable	— Almost inconceivable that the event will occur	1

Figure 2: Example of severity table

Severity	Meaning	Value
Catastrophic	— Aircraft or equipment destroyed — Several fatalities	A
Hazardous	— Greatly reduced safety margins, physical stress or a workload such that operations personnel can no longer be relied upon to perform their tasks accurately or completely — Severe injuries — Significant damage to equipment	B
Major	— Significant reduction in safety margins, reduced ability of operations personnel to tolerate adverse operating conditions, as a result of increased workload or as a result of conditions affecting their efficiency — Serious incident — Injuries to people	C
Minor	— Operational limitations — Use of emergency procedures — Minor incident	D
Negligible	— Few consequences	E

Figure 3: Examples of risk assessment matrices

Probability of risk	Severity of risk				
	Catastropic A	Hazardous B	Major C	Minor D	Negligible E
Frequent 5	5A	5B	5C	5D	5E
Occasional 4	4A	4B	4C	4D	4E
Remote 3	3A	3B	3C	3D	3E
Improbable 2	2A	2B	2C	2D	2E
Extremely improbable 1	1A	1B	1C	1D	1E

Risk index range	Description of risk	Recommended action
5A, 5B, 5C, 4A, 4B, 3A	Intolerable	Take immediate action to mitigate risk or suspend the activity. Carry out priority safety risk mitigation to ensure that preventive or additional or enhanced controls are in place to reduce the risk index to the tolerable range.
5D, 5E, 4C, 4D 4E, 3B, 3C, 3D, 2A, 2B, 2C, 1A	Tolerable	May be tolerated based on safety risk mitigation. May require a management decision to accept the risk.

3E, 2D, 2E, 1B, 1C, 1D, 1E	**Acceptable**	Acceptable as is. No further risk mitigation required.

Appendix E. Publication model – UPR

User-preferred routes

User-preferred routes (UPR) are routes requested by airlines that optimise routing between specific city pairs. UPRs must be approved by all air navigation service providers (ANSPs), through their flow management units, area control centre managers, or civil aviation authorities, as appropriate, responsible for the provision of air traffic services on any segment of the UPR. Upon publication, airlines will be able to use these segments for any city pair until their cancellation or modification.

UPRs may undergo a trial period, in which case they will be available for a specific period of time (that is, a trial period) and for a specific airline. Route trials are intended to determine the operational viability of routes and once operational viability has been verified, the routes will be published following the process described below.

Aircraft shall use the UPR starting from one of the following waypoints:
a) published ATS route; or
b) last waypoint of a published departure procedure (SID); or
c) boundary of an area where strategic direct routing (SDR) is applied.

UPRs are published on the website of the air navigation service provider at: xxxxxxxxxxxxxxxxxxxx

The complete UPRs, which go beyond the boundaries of national FIRs, can be found on the ICAO SAM Office portal/website: XXXXXXXXXXXXXXXXXXXXXXXXXX

Appendix F. Publication model - SDR

IMPLEMENTATION OF STRATEGIC DIRECT ROUTING IN THE UPPER AIRSPACE OF THE XXXX FIR

1. PURPOSE

1.1. The purpose of this AIP Supplement is to inform users of the upper airspace of the XXXX FIR about the implementation of ASBU element FRTO B0/1 - Direct Routing (DCT) set forth in the sixth edition of the Global Air Navigation Plan of the International Civil Aviation Organization (ICAO), known as Strategic Direct Routing (SDR) in Spanish, under the procedures described below.

2. INTRODUCTION

2.1. Over the last 10 years, a complete restructuring of the South American (SAM) ATS route network has taken place, involving the realignment and/or elimination of inefficient paths, as well as the implementation of new routes, resulting in a more direct and optimised fixed route structure.

2.2. The use of fixed ATS routes can no longer provide the efficiency required by airspace users. SDR implementation has been established in order to offer users additional options when selecting more efficient paths/routes, and to optimise flight planning and fuel consumption, through the filing of flight plans (FPLs) with direct routes.

2.3. SDR implementation is a natural evolution in airspace use optimisation and a transition to the use of the free-route airspace (FRA) concept, as envisaged in the Global Air Navigation Plan (GANP).

3. OPERATIONAL PROCEDURES

3.1. Area of application

3.1.1. Strategic Direct Routing (SDR) will be applied in the upper airspace, in the area between the following points/coordinates and time schedules:

(on a State-by-State basis)

3.2. Flight plans

3.2.1. Flight plans will be filed in accordance with the tables of cruising level contained in Appendix 3 to ICAO Annex 2.

3.2.2. The flight plan must be based on published significant points (waypoints) or radio navigation aids and the distance must not exceed xxx NM.

3.2.3. The flight plan shall contain a significant point (waypoint) or reporting point (LAT/LONG) at FIR boundaries.

3.3. Contingency

3.3.1. SDRs may be temporarily suspended in that part of airspace subject to:

a) partial or full activation of contingency plans;

b) impairment of ATS surveillance service;

c) degradation of VHF communications; or

d) degradation of the flight plan system.

4. ADDITIONAL INFORMATION

4.1.1. Additional information can be obtained through the following VHF contact:

(on a State-by-State basis)

Note 1: It will be up to each State to adapt this model to meet local specificities.

Note 2: A chart representing the area of SDR application may be attached if the State does not have a DASA-equivalent system.

Appendix G. Acronyms, abbreviations and definitions

Acronyms

ADAP - Automated Downlink of Airborne Parameters
ADS-B – Automatic Dependent Surveillance - Broadcast
ADS-C - Automatic Dependent Surveillance - Contract
AIDC - ATS Interfacility Data Communications
ANP – Air Navigation Plan
ANSP – Air Navigation Service Provider
APTA - Improved Arrival and Departure Operations
ASBU - Aviation System Block Upgrades
ATFM - Air Traffic Flow Management
ATM – Air Traffic Management
CAA – Civil Aviation Authority
CANSO – Civil Air Navigation Services Organisation
CDR – Coded Departure Routes
CPDLC - Controller-Pilot Data Link Communications
DASA – Digital Airspace System Analysis
SDR – Strategic Direct Routing
FRA – Free-Route Airspace
FICE - Flight and Flow Information for a Collaborative Environment
FUA – Flexible Use of Airspace
GANP – Global Air Navigation Plan
GASP - ICAO Global Aviation Safety Plan
KPA – Key Performance Area
KPI – Key Performance Indicator
LoA – Letter of Agreement
LTAG - Landing and Take-off Green Procedures/ Long-Term Aspirational Goal
MONA – Monitoring Aids
MTCD – Medium-Term Conflict Detection
ICAO – International Civil Aviation Organization
PBCS - Performance-Based Communication and Surveillance
PBN – Performance-Based Navigation
RTK - Revenue Tonne-Kilometre
SAF - Sustainable Aviation Fuel
SARPs - Standards and Recommended Practices
TRA – Temporary Reserved Area
TSA – Temporary Segregated Area
UPR - User-Preferred Route

Abbreviations

TBD

Definitions

TBD

Appendix H. Reference documents

The following documents are related to the Guidance for Implementation of Improved Operations through Enhanced En-Route Trajectories (FRTO):

- Annex 2 – Rules of the Air, twelfth edition, 2006
- Concept of operations for efficiency and capacity in SAM airspace, 2022
- Concept for free-route airspace (FRA) implementation in the AFI Region, Appendix 3E – First edition
- Doc 9750 - Global Air Navigation Plan (GANP), seventh edition, 2022
- Doc 9854 - Global air traffic management operational concept, 2005
- Doc 9883 Manual on global performance of the air navigation system, 2009
- Doc 10004 Global aviation safety plan, 2022
- Doc 10088 Manual on Civil-Military Cooperation in Air Traffic Management, 2021.
- Specification for the application of the flexible use of airspace, EUROCONTROL, 2009
- Performance-based optimisation of SAM airspace, CONOPS and Roadmap, 2022
- CAR/SAM air navigation plan - Volume III, Appendix B, 2014
- Resolutions adopted by GREPECAS – Working paper 15 (Santo Domingo – Dominican Republic, 15-17 November 2023)

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APENDICE B / APPENDIX B

ACTION PLAN NEOSPACE-1 – SAM REGION

Deliverables	GANP References	Accountable (s)	Status	Delivery Date	Comments
Development of regional guidance material on implementation of the FRTO module, and EDE and UPR concepts	Selected FRTO module elements	Regional Offices States Industry			
FRTO implementation roadmap CAR/SAM region.	Selected FRTO module elements	Regional Offices States Industry			
Review of the APTA CAR Region implementation roadmap.	Selected elements of the APTA module	Regional Offices States Industry			Within the framework of Assembly Resolution, A37-11.
Review of the APTA SAM Region implementation roadmap	Selected elements of the APTA module	Regional Offices States Industry			Within the framework of Assembly Resolution, A37-11.
Follow-up implementation of UPR, SDR and EDE	Selected elements of the APTA module	ICAO Regional Offices Project Coordinators			
Set a goal for the implementation of UPR, EDE and FRA in the next 5 years	Selected elements of the APTA module	Regional Offices States Industry			

Harmonize UPR and SDR publication	Selected elements of the APTA module	States			AIP Publication based on Guidance Material model - SDR in ENR 2.2 and UPR in ENR 3.5
Establish KPIs	Selected elements of the APTA module	Regional Offices States Industry			
Longitudinal Separation?					

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APPENDIX C

OVERARCHING DOCUMENT

¨Harmonized Horizons: Airspace Optimization in CAR-SAM Regions¨

The International Civil Aviation Organization (ICAO) recognizes the critical importance of airspace optimization in ensuring safe, efficient, and sustainable air traffic management. The North American, Central American, and Caribbean (NAM/CAR) Region and the South American (SAM) Region, though diverse in their complexities and operational environments, share a common goal of enhancing airspace management. This document serves as an overarching framework to foster collaboration between the two regions, supporting individual and collective efforts toward airspace optimization.

Regional Overview

NAM/CAR Region

The NAM/CAR Regions are characterized by a diverse airspace environment, with a significant portion of the Caribbean region being over water, which presents unique challenges in airspace management. The region is focused on implementing advanced technologies and procedures to enhance en-route and terminal operations, optimize airspace structure, and improve Air Traffic Flow Management (ATFM).

SAM Region

The SAM Region, encompassing a vast and diverse geographical area, faces different operational complexities, including high-altitude terrain and varied traffic densities. The region is dedicated to modernizing its air traffic management infrastructure, improving CNS (Communication, Navigation, and Surveillance) capabilities, and enhancing safety and efficiency through collaborative efforts.

Collaborative Goals and Objectives

1. Harmonization of Standards and Procedures:
   - Develop and implement harmonized air traffic management (ATM) standards and procedures to ensure seamless operations across regional boundaries.
   - Promote the adoption of best practices and innovative technologies to enhance airspace safety and efficiency.
2. Capacity Building and Training:
   - Facilitate joint training programs and workshops to build capacity and enhance the skills of aviation professionals in both regions.

- Encourage knowledge sharing and exchange of expertise to address common challenges and leverage collective strengths.

3. Data-Driven Decision Making:
   - Utilize data analytics and performance metrics to inform decision-making processes and measure the effectiveness of airspace optimization initiatives.
   - Implement Key Performance Indicators (KPIs) aligned with ICAO's Global Air Navigation Plan (GANP) to track progress and ensure accountability.
4. Enhanced Communication and Coordination:
   - Establish robust communication channels and coordination mechanisms between the NAM/CAR and SAM regions to support collaborative planning and execution of airspace optimization projects.
   - Foster a culture of cooperation and mutual support to address regional disparities and ensure no country is left behind.

Key Initiatives and Projects

- Free Route Airspace Implementation:

Both regions will work towards implementing Free Route Airspace (FRA), enabling aircraft to fly more direct routes, reducing fuel consumption, and minimizing environmental impact.

- Air Traffic Flow Management (ATFM) Enhancement:

Collaborative ATFM initiatives will be undertaken to improve traffic flow, reduce delays, and optimize airspace capacity.

- Upper Airspace Agreement:

An agreement between the NAM/CAR and SAM Regions will be established to facilitate seamless operations in upper airspace, enhancing safety and efficiency for overflying aircraft.

Short Term common Initiatives on Airspace Optimization in CAR and SAM Regions

- Publication of current and future SDR and UPR based on the models of Attachments A and B.
- Harmonization of SDR publication in AIP ENR 2.6 and UPR publication in the AIP ENR 3.5.
- Use of UPRs playbook published in the ANSPs and/or in the ICAO office´s webpages.
- Optimize Longitudinal Separation for 20 NM in non-ATS surveillance airspace and 10 NM in ATS Surveillance Airspace.

Conclusion

The collaboration between the ICAO NAM/CAR and SAM Regions is vital to achieving the overarching goals of airspace optimization and ensuring the safe, efficient, and sustainable management of global air traffic. By working together, leveraging shared expertise, and addressing regional complexities, both regions can enhance their airspace capabilities and contribute to the global aviation community's advancement. This document serves as a bridge, reinforcing the commitment to collaboration and continuous improvement while respecting the unique needs and goals of each region.

Attachment A

Publication model – UPR

User-preferred routes

User-preferred routes (UPR) are routes requested by airlines that optimise routing between specific city pairs. UPRs must be approved by all air navigation service providers (ANSPs), through their flow management units, area control centre managers, or civil aviation authorities, as appropriate, responsible for the provision of air traffic services on any segment of the UPR. Upon publication, airlines will be able to use these segments for any city pair until their cancellation or modification.

UPRs may undergo a trial period, in which case they will be available for a specific period of time (that is, a trial period) and for a specific airline. Route trials are intended to determine the operational viability of routes and once operational viability has been verified, the routes will be published following the process described below.

Aircraft shall use the UPR starting from one of the following waypoints:

a) published ATS route; or
b) last waypoint of a published departure procedure (SID); or
c) boundary of an area where strategic direct routing (SDR) is applied.

UPRs are published on the website of the air navigation service provider at: xxxxxxxxxxxxxxxxxxxx

The complete UPRs, which go beyond the boundaries of national FIRs, can be found on the ICAO SAM Office portal/website: XXXXXXXXXXXXXXXXXXXXXXXXX

Attachment B

Publication model - SDR

IMPLEMENTATION OF STRATEGIC DIRECT ROUTING IN THE UPPER AIRSPACE OF THE XXXX FIR

1. PURPOSE

1.1. The purpose of this AIP Supplement is to inform users of the upper airspace of the XXXX FIR about the implementation of ASBU element FRTO B0/1 - Direct Routing (DCT) set forth in the sixth edition of the Global Air Navigation Plan of the International Civil Aviation Organization (ICAO), known as Strategic Direct Routing (SDR) in Spanish, under the procedures described below.

2. INTRODUCTION

2.1. Over the last 10 years, a complete restructuring of the South American (SAM) ATS route network has taken place, involving the realignment and/or elimination of inefficient paths, as well as the implementation of new routes, resulting in a more direct and optimised fixed route structure.

2.2. The use of fixed ATS routes can no longer provide the efficiency required by airspace users. SDR implementation has been established in order to offer users additional options when selecting more efficient paths/routes, and to optimise flight planning and fuel consumption, through the filing of flight plans (FPLs) with direct routes.

2.3. SDR implementation is a natural evolution in airspace use optimisation and a transition to the use of the free-route airspace (FRA) concept, as envisaged in the Global Air Navigation Plan (GANP).

3. OPERATIONAL PROCEDURES

3.1. Area of application

3.1.1. Strategic Direct Routing (SDR) will be applied in the upper airspace, in the area between the following points/coordinates and time schedules:

(on a State-by-State basis)

3.2. Flight plans

3.2.1. Flight plans will be filed in accordance with the tables of cruising level contained in Appendix 3 to ICAO Annex 2.

3.2.2. The flight plan must be based on published significant points (waypoints) or radio navigation aids and the distance must not exceed xxx NM.

3.2.3. The flight plan shall contain a significant point (waypoint) or reporting point (LAT/LONG) at FIR boundaries.

3.3. Contingency

3.3.1. SDRs may be temporarily suspended in that part of airspace subject to:

a) partial or full activation of contingency plans;
b) impairment of ATS surveillance service;
c) degradation of VHF communications; or
d) degradation of the flight plan system.

4. ADDITIONAL INFORMATION

4.1.1. Additional information can be obtained through the following VHF contact:

(on a State-by-State basis)

Note 1: It will be up to each State to adapt this model to meet local specificities.
Note 2: A chart representing the area of SDR application may be attached if the State does not have a DASA-equivalent system.

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APÉNDICE D / APPENDIX D

Region **CAR/SAM**	**PROJECT DESCRIPTION**	**N° NEOSPACE – 1** **Rev.01 by GREPECAS 22**	
Programme	**Title**	**Start**	**End**
***CAR/SAM* Airspace Optimization** Coordinators RO NACC Josue González RO SAM Fernando Hermoza	Implementation of APTA and FRTO modules of the GANP to increase performance of efficiency, capacity, and safety Project coordinators ▪ *Julio Cesar de Souza Pereira (IATA)* • *Riaaz Mohammed (Trinidad and Tobago)* ▪ *XXXX XXXXX (SAM TBD)*	JAN 2024	DEC 2027
1. Objectives	Recognizing the current progress of implementation activities for certain elements of the APTA and FRTO modules of the GANP[1], it is required: a) Support and reorient the optimization of the airspace structure of the CAR/SAM Region in a harmonized and coherent manner, strengthening ongoing implementations. b) Promote the activities of the States and CAR/SAM organizations for the effective implementation of Volume III of the ANP CAR/SAM. c) Generate environmental benefits by saving fuel and reducing CO_2 emissions.		
2. Scope	✓ Initiate and/or reinforce the implementation of selected elements of the GANP FRTO module[2]: a) to increase performance in the area Efficiency, in the focal areas; flight time, distance and vertical flight, focusing on fuel savings and CO_2 emissions; and b) to increase performance in the area Safety, in specific objectives of avoiding deviations in lateral/horizontal navigation and improving the early detection of conflicting ATC authorizations. ✓ Initiate and/or reinforce the implementation of selected elements of the GANP APTA module (Approach, SID/STAR, CDO and CCO) to increase performance in the area Capacity, in the focal areas, capacity, performance and utilization. ✓ Evaluate and implement the necessary CNS/ATM enablers to FRTO and APTA ✓ Optimize longitudinal separation in continental space, to increase performance in the Efficiency and Capacity area.		

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1 *See GANP portal: https://www4.icao.int/ganpportal/*

2 *The project starts with the planning of FRTO and APTA modules of Blocks 0 and 1. From 2025, Block 2 is incorporated according to the GANP.*

3. Supporting metrics	✓ Number of SID/STAR PBN routes implemented, where required for International Airports (Application of CCO and CDO techniques) ✓ Number of RNAV/RNP routes implemented (new routes/improved navigation specification/replacement of conventional routes). ✓ Number of Flight Information Regions that have implemented strategic direct routing (SDR). Volume of airspace implemented. ✓ Number of Flight Information Regions that have implemented Free Route Airspace (FRA). Volume of airspace implemented. ✓ Number of routes preferred by the UPR user implemented. ✓ Percentage of thresholds with APV approaches in International Airports. ✓ Reduction of fuel consumption and CO2 emissions ✓ Other metrics that are applicable.
4. GANP Key performance indicators (KPI)	o According to the project planning, FRTO and APTA elements and respective KPI indicators (GANP and Doc. 9883 performance-based planning process) will be selected. Performance improvement targets require the definition of a baseline for KPIs. From this baseline, it is feasible to establish performance improvement ambitions for a given KPI, within a defined period. o Proposed project KPIs are shown below (States/Organizations, according to their needs, can calculate/monitor other GANP KPIs or develop their own indicators) **APTA MODULE** **Basic Indicator - Capacity** KPI 10 – Airport peak throughput **Advanced Indicators - Efficiency** KPI 17 – Level-off during climb KPI 19 - Level-off during descent **FRTO MODULE** **Basic Indicators - Efficiency** KPI 04 – Filed flight plan En-route extension. KPI 05 – Actual en-route Extension **Basic Indicators – Safety** KPI20 – Number of aircraft accidents KPI23 – Number of airprox events/TCAS alerts/separation loss/mid-air near collision/mid-air collision (MAC) **Advanced Indicators - Efficiency** KPI 17 – Level-off during climb KPI 19 - Level-off during descent **Advanced Indicator – Capacity** KPI 06 – En-route Airspace capacity
5. Strategy	o The execution of the Project activities will be coordinated through communications between Project members, the Project Coordinators, and the Program Coordinator through meetings of the implementation groups in CAR and SAM. Other events or

	deliverables (studies, guidance material, workshops, etc.) are considered. The use of a common implementation guide for the CAR/SAM Regions will ensure the necessary harmonization, mainly in the interfaces of both regions. o By semester, a coordination meeting should be held between SAMIG/GESEA and NACC WG/AOTF. o The project recognizes the need to continue supporting the recovery of air connectivity in CAR and SAM, through optimization of efficiency and capacity. It is expected to strengthen interregional and intraregional harmonization for the implementation of FRTO and APTA. o At the same time, the project promotes the work of States/Organizations to strengthen their capacities in performance-based planning, promoting the formulation, calculation and monitoring of GANP KPI indicators, which advances in the management of Volume III[3] of the ANP CAR/SAM Regional Plan. See below on line 6 the processes to make this transition. o Collaborative work with all stakeholders is envisaged; ANSP, States, Users, Airlines, Organizations, and Industry.
6. Targets	Progress will be made progressively, starting with the implementation of UPR and SDR, progressing gradually until the regional FRA is reached. In addition, within the scope of APTA, regional guides will be provided for the restructuring of the main MADAs, with a view to achieving integration between UPR/SDR/FRA and the arrival/approach and departure phases. The formulation of KPI baselines will be carried out, towards the management of these indicators in the context of performance improvement ambitions. Three processes are defined: 1. Process 1 (no later than December 2025): Defined targets are stipulated and monitored based on supporting metrics. Simultaneously, States reinforce and/or complete baseline calculation activities for selected KPIs. 2. Process 2 (no later than December 2026): Defined targets are monitored based on supporting metrics. States complete the KPI baselines, and monitoring of these indicators begins. 3. Process 3 (no later than December 2027): Establishment of target monitoring based on KPIs. Support metrics are used only as a complementary reference for the implementation progress.
7. Justification	o GREPECAS/20 identified that activities in the CAR/SAM region are advancing together with the industry, and harmonization between them should begin as soon as possible. It was agreed that these initiatives should be grouped under a single GREPECAS Program, to develop in a harmonized and interoperable manner the concepts for the optimization of airspace that cover, in addition to PBN implementation, several modules/operational elements of the GANP. o This project focuses on the key performance areas (KPA) **Capacity, Efficiency and Safety** in order to reduce the gap between the actual flight path and the optimal trajectory desired by users. Likewise, implement routes and instrument flight procedures that increase the airport's arrival ratio and increase accessibility to the airport, while ensuring operational safety. o The project supports the optimization of the airspace structure of CAR/SAM regions that is in progress since the beginning of the implementation of the APTA module in 2013, as well as the implementation of the FRTO module that was initiated through several initiatives in CAR and SAM after the pandemic period, with a view to supporting the recovery and sustainability of the Industry, as well as restoring air connectivity. o At the same time, the effective implementation of Volume III of the ANP CAR/SAM is promoted.

[3] *Volume III stipulates the dynamic/flexible plan elements by providing implementation planning guidelines for air navigation systems*.

8. Related projects	A2 - Air Navigation Systems in support of PBN. B1 - Improving the balance between demand and capacity.

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TABLES OF ACTIVITIES

1. FRTO IMPLEMENTATION ACTIVITIES AND PLANNING
2. APTA IMPLEMENTATION ACTIVITIES AND PLANNING

Colour-Legend

Grey	*Task not started.*
Green	*Activity in progress according to schedule.*
Yellow	*Activity started with some delay but would be arriving on time in its implementation.*
Red	*The implementation of the activity has not been achieved in the estimated period; it is necessary to adopt mitigating measures.*

1. FRTO IMPLEMENTATION ACTIVITIES AND PLANNING

ITEM	Deliverables	GANP references	Accountables	Status	Delivery date	Comments
1.	Development of regional guidance material on implementation of the FRTO module, and SDR and UPR concepts	Selected FRTO module elements	Regional Offices States Industry			
2.	FRTO implementation roadmap CAR/SAM region.	Selected FRTO module elements	Regional Offices States Industry			
3.	Follow-up implementation of UPR, SDR and EDE	Selected elements of the APTA module	ICAO Regional Offices			

ITEM	Deliverables	GANP references	Accountables	Status	Delivery date	Comments
			Project Coordinators			
4.	Set a goal for the implementation of UPR, EDE and FRA in the next 5 years	Selected elements of the APTA module	Regional Offices States Industry			
5.	Harmonize UPR and SDR publication	Selected elements of the APTA module	States			AIP Publication based on Guidance Material model - SDR in ENR 2.2 and UPR in ENR 3.5
6.	Establish KPIs	Selected elements of the APTA module	Regional Offices States Industry			
7.	Optimize Longitudinal Separation to 20NM (without ATS surveillance) and 10 NM		Regional Offices States Industry			
8.						
9.						

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2. APTA IMPLEMENTATION ACTIVITIES AND PLANNING

ITEM	Deliverables	GANP references	Accountables	Status *	Delivery date	Comments
1.	Review of the APTA CAR Region implementation roadmap.	Selected elements of the APTA module	*Regional Offices States Industry*			Within the framework of Assembly Resolution, A-37-11.
2.	Review of the APTA SAM Region implementation roadmap.	Selected elements of the APTA module	*Regional Offices States Industry*			Within the framework of Assembly Resolution, A-37-11.
3.						
4.						
5.						
6.						
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