INTERNATIONAL CIVIL AVIATION ORGANIZATION

SUB-PROJECT TO DEVELOP AND IMPLEMENT AN OPTIMIZED AIRSPACE CONCEPT DOCUMENT FOR THE CAR REGION

ICAO REGIONAL TECHNICAL COOPERATION PROJECT — "MULTI-REGIONAL CIVIL AVIATION ASSISTANCE PROGRAMME (MCAAP)" (RLA/09/801)
26-29 July 2022

WORKING DRAFT 1.0
29-July-2022

by

Ernest Snyder
Riaaz Mohammed
Luis Rosales
William Alsina

ICAO Representative:	Ernest Snyder ATM/SAR NACC Regional officer
Place of Mission:	ICAO NACC Regional Office Mexico City, Mexico
Dates of Mission:	26-29 July 2022
Objectives of the Mission:	● Develop an Optimized Airspace concept for the CAR region, which includes harmonized separation standards, airspace restructuring, Performance Based Navigation and Free Route Airspace. Goals where established for the optimization of airspace to allow continuous flow in the upper and lower airspace of contiguous Flight Information Regions (FIRs) and TMAs.
Summary of Activities:	● Initial meeting with the SMEs to discuss the sub-project mission objectives. ● Identify requirements for the development of an optimized airspace concept for the CAR region. ● Consider a methodology to assess the readiness of each State to transition to FRA. ● Draft a report summarizing the sub-project mission outcomes.

CONTENT

1. Introduction

1.1 The Sub-Project to develop and Implement an optimized airspace concept document for the CAR Region involved Subject Matter Experts (SMEs) selected among Project Member States and led by the ICAO NACC Regional Office. This document includes recommendations for harmonized separation standards, airspace restructuring, continued implementation of Performance Based Navigation (PBN) and establishes a goal to transition to Free Route Airspace (FRA).

1.2 The GANP will be used as guidance to determine the generic requirements to optimize the airspace of the CAR Region including the transition to Free Route Airspace (FRA).

1.3 The Airspace Optimization (ASO) Taskforce will develop a methodology for future assessment of the readiness of each State to transition to FRA.

1.4 The SMEs collaborated with the CIIFRA team on the development of the optimized airspace concept and the transition roadmap for the CAR Region.

2. Objectives

2.1 The main objective of this document is to follow up with the ICAO program No Country Left Behind (NCLB) in the process of airspace optimization. The Airspace Optimization (ASO) Taskforce will collaborate with the States to assist them with the individual airspace optimization plans.

2.2 Specific objectives:

The CAR Region Airspace Optimization has the next specific objectives:

Safety: Reduce ATS incidents, Controlled Flights Into Terrain (CFIT), trough harmonization of airspace and improvement of STARs, SIDs and APPs designs.

Capacity: Allow a more flexible use of airspace to avoid saturation of traffic over determined areas.

Efficiency: Reduce work overload for crewmembers and Air Traffic Controllers.

Environment: Reduce CO2 emissions and noise over sensitive areas.

2.3 Benefits

Help States to comply with Aviation System Block Upgrade (ASBU) airspace optimization requirements.

Increase harmonization between adjacent States.

Reduce aircraft navigational equipment requirements.

Reduce distance travelled from point to point for each aircraft operation.

Improve aircrafts Fuel savings and reduction of CO_2 emissions.

Increase continuous climb and descend operations for aircraft.

Reduce the use of holding patterns.

Provide greater access through mountainous areas.

Reduce noise in the vicinity of airports.

Reduce pilot and Air Traffic Control (ATC) workload.

Reduce radio congestion.

Reduce ANSP operational cost through the reduction of the requirement for ground navaids.

Reduce GPWS.

Increase flexible use of airspace.

3. Scope

3.1 This optimized airspace concept is intended for the following States/Organizations of the Caribbean (CAR) Region:

UPPER AIRSPACE	LOWER AIRSPACE
COCESNA (CENTRAL AMERICA)	BELIZE (BELIZE TMA)
	GUATEMALA (LA AURORA TMA)
	HONDURAS (LA MESA TMA; TONCONTIN TMA;ROATAN ATZ; LA CEIBA CTR; PALMEROLA)
	EL SALVADOR (EL SALVADOR TMA)
	NICARAGUA (MANAGUA TMA)
	COSTA RICA (EL COCO TMA; LIBERIA TMA)

MEXICO (MEXICO, MAZATLAN OCEANIC, MERIDA)	ACAPULCO; CANCÚN-COZUMEL; CIUDAD DEL CARMEN; CIUDAD JUAREZ;CIUDAD OBREGON; CIUDAD VICTORIA; CULIACÁN;CHIHUAHUA; DURANGO; GUADALAJARA; HERMOSILLO; IXTAPA-ZIHUATANEJO; LA PAZ; LOS MOCHIS; LEÓN - AGUASCALIENTES; MANZANILLO; MATAMOROS; MAZATLAN; MERIDA; MEXICO CITY; MONTERREY; MORELIA; NUEVO LAREDO; OAXACA; PUEBLA; PUERTO VALLARTA; QUERÉTARO; REYNOSA; SALTILLO; SAN JOSE DEL CABO; SAN LUIS POTOSÍ; TAMPICO; TIJUANA; TORREÓN; TUXTLA GUTIÉRREZ; VERACRUZ; VILLAHERMOSA;
JAMAICA (KINGSTON)	JAMAICA TMA;
HAITI (PORT AU PRINCE)	PORT AU PRINCE TMA
CUBA (HAVANA)	HAVANA TMA; SANTA CLARA TMA; SANTIAGO TMA
CURACAO (CURACAO)	CURACAO TMA; JULIANA TMA; BEATRIX CTR; FLAMENGO CTR;
DOMINICAN REPUBLIC (SANTO DOMINGO)	PUNTA CANA TMA; LAS AMERICAS TMA; CIBAO TMA
UNITED STATES (SAN JUAN)	SAN JUAN
TRINIDAD AND TOBAGO (PIARCO)	TRINIDAD AND TOBAGO (PIARCO CTR)
	ANTIGUA AND BARBUDA (VC BIRD TMA)
	BARBADOS (ADAMS TMA)
	MARTINIQUE (MARTINIQUE TMA)
	ST LUCIA (ST LUCIA CTR)
	ST VINCENT AND THE GRENADINES (ARGYLE TMA)
	GRENADA (MAURICE BISHOP TMA)
	GUADELOUPE (POINTE-A-PITRE-TMA)

Note: Due to the high flow of traffic and airspace complexity that exists between the CAR Region and the Miami Oceanic, Houston Oceanic and New York Oceanic FIRs, it is recommended that a point of contact from these FIRs be established to coordinate with the rest of the Region.

4. Airspace Optimization Concept

4.1 General

4.1.1 The Airspace Optimization Concept is a plan to benefit all current and envisioned users of the airspace by improving safety, capacity and efficiency of operations in the CAR Region.

4.1.2 Airspace Optimization utilizes all available technologies, procedures and concepts, including **harmonized separation standards, airspace restructuring, PBN and FRA.**

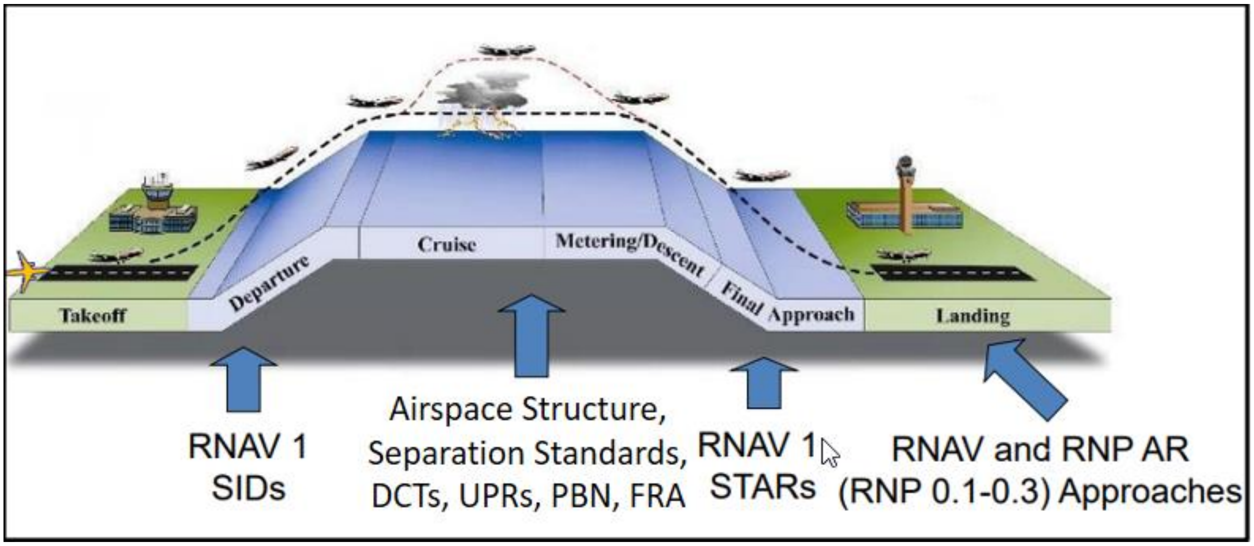

Image 1. Airspace Optimization throughout all phases of flight.

4.2. Goals for the Airspace Optimization

4.2.1 The following table reflects the goals established by the taskforce to meet the Specific Objectives of Airspace Optimization in the Region:

	Specific Objective				Goals
	Saf.	Cap.	Eff.	Env.	
Airspace Optimization		x	x	x	Implementation of RNAV 5 routes as agreed to in the Regional ANP.
		x	x	x	Continue the airspace optimization already begun in point to point trajectories, UPR trials and eventual transition to FRA.
		x	x	x	Conduct an analysis for the implementation of RNP 2 for continental airspace routes.
		x	x	x	Decide upon a date for the regional implementation of RNP 4 for oceanic airspace routes.
		x	x	x	For Oceanic airspace, use of 30 NM longitudinal and

					lateral separation (WHERE APPLICABLE) and 50 NM separation for all other oceanic areas.
	x				Removal of conventional routes made redundant by PBN route implementation.
	x	x	x	x	Harmonization of upper airspace routes with RNAV/RNP 1 STAR/SIDs (CCOs and CDOs) of TMAs within the FIR.
		x	x	x	For continental airspace, implementation of 20 NM longitudinal separation at FIR Boundaries (WHERE APPLICABLE).
	x	x	x	x	Implementation of RNAV/RNP 1 STAR/SIDs (CCOs and CDOs) to TMAs within the FIRs.
	x				Implementation of LNAV approaches for those International Airports so determined.
	x				Implementation of LNAV/VNAV (BARO VNAV) Approaches if analysis determines a benefit.
	x		x	x	Implementation of RNP AR Approaches/Departures if analysis determines a benefit.
	x		x	x	Implementation of APV (GLS/LPV) Approaches if analysis determines a benefit.

4.3 Harmonized Separation Standards

4.3.1 For continental airspace, implementation of 20NM longitudinal separation at FIR Boundaries (WHERE APPLICABLE).

4.3.1.1 This requirement is based on the Longitudinal Separation Minima based on distance using Distance Measuring Equipment (DME) and/or GNSS.

4.3.1.2 Separation shall be established by maintaining not less than specified distance(s) between aircraft positions as reported by reference to DME in conjunction with other appropriate navigation aids and/or GNSS. This type of separation shall be applied between two aircraft using DME, or two aircraft using GNSS, or one aircraft using DME and one aircraft using GNSS. Direct controller-pilot VHF voice communication shall be maintained while such separation is used.

4.3.1.3 For oceanic airspace, use of 50 NM lateral separation.

4.3.1.4 RNAV 10 (designated and authorized as RNP 10) supports 50 NM lateral and 50 NM longitudinal distance based separation minima in oceanic or remote area airspace.

4.3.1.5 For oceanic airspace, use of 30 NM longitudinal and lateral separation.

4.3.1.6 RNP 4 supports 30 NM lateral and the 30 NM longitudinal distance based separation minima in oceanic or remote area airspace.

4.3.1.7 The taskforce acknowledges there are varying separation standards utilized by ANSPs across the Region and this leads to inefficient operations. The taskforce will continue the work that has already begun to harmonize the separation standards across FIRs boundaries.

4.3.1.8 An analysis will be conducted to determine the timeline for the implementation of RNP 4 for oceanic airspace. This will required collaboration between the Taskforce, ANSPs and Airline Operators.

4.4 Airspace Structure

4.4.1 The taskforce acknowledges that the current structure of regional airspace may be improved in order to achieve greater efficiencies.

4.4.2 The taskforce will analyze the regional airspace and seek to identify those portions of airspace that may be improved through redesign or gain benefit through functional use of airspace.

4.5 PBN Airspace Standards

4.5.1 Implementation of RNAV 5 routes as agreed to in the Regional ANP.

4.5.1.1 RNAV 5 operations are based on the use of RNAV equipment which automatically determines the aircraft position in the horizontal plane using input from one or a combination of the following types of position sensors, together with the means to establish and follow a desired path: a) VOR/DME; b) DME/DME; c) INS or IRS; and d) GNSS.

4.5.1.2 The ANSP must assess the navaid infrastructure in order to ensure that it is sufficient for the proposed operations, including reversionary modes. It is acceptable for gaps in navaid coverage to be present; when this occurs, route spacing and obstacle clearance surfaces need to take account of the expected increase in lateral track-keeping errors during the "dead reckoning" phase of flight.

4.5.1.3 Regarding separation, in an ATC surveillance environment, the route spacing will depend on acceptable ATC workload and availability of controller tools, separation is consider as follows:

18 NM for opposite direction routes,

16.5 NM for same direction routes, and

As low as 10 NM where ATC intervention capability permits.

4.5.2 Removal of conventional routes made redundant by PBN route implementation.

4.5.2.1 RNAV/RNP routes are more efficient than conventional routes providing "gate to gate" operations and also don't rely on radioaids installed on ground, improving safety and accuracy. Those are the main reason why it is consider important to replace conventional routes to RNAV/RNP routes, mainly where they are superposed.

4.5.3 Implementation of RNAV/RNP 1 STAR/SIDs (CCOs and CDOs) to TMAs within the FIRs.

4.5.3.1 The main objective is to improve safety, predictability of flights and airspace capacity while reducing noise, fuel consumption, emissions and pilot-controller communications at the same time.

4.5.3.2 CDO is an aircraft operating technique aided by appropriate airspace and procedure design and appropriate ATC clearances enabling the execution of a flight profile optimized to the operating capability of the aircraft, with low engine thrust settings and, where possible, a low drag configuration, thereby reducing fuel burn and emissions during descent. The optimum vertical profile takes the form of a continuously descending path, with a minimum of level flight segments only as needed to decelerate and configure the aircraft or to establish on a landing guidance system (e.g. ILS).

4.5.3.3 Continuous climb operations (CCO) is an aircraft operating technique enabled by airspace design, instrument procedure design and facilitation by ATC, allowing for the execution of a flight profile optimized to the performance of the aircraft. CCO enables the aircraft to attain initial cruise flight level at optimum airspeed and engine thrust settings set throughout the climb, thereby reducing total fuel burn and emissions. Ideally, the departure design is such that arriving traffic is also able to descend based on an optimum descent profile. Where the departure and arrival flows cannot be designed independently, there will need to be a compromise between the needs of the departure and arrival flow optimization; this compromise should be reached collaboratively.

4.5.3.4 An aircraft's fuel efficiency in terms of fuel burned per kilometre flown in level flight increases with height. However, the fuel used in climbing to that altitude can be a significant part of the overall fuel used for the flight. Therefore, for any given route length, there is an optimum initial cruise flight level which will be dependent upon the aircraft type and mass, as well as on the meteorological conditions of the day. CCO is only one of the tools involved in a complete airspace design. Throughout the design process, CDO, CCO and other route modifications should all be considered.

4.5.4 Implementation of LNAV approaches for those International Airports so determined.

4.5.4.1 RNP APCH LNAV procedures provides lateral guidance and can be defined with fly-by and fly-over waypoints as "T" or "Y" type approach.

4.5.4.2 RNP APCH is defined as an RNP approach procedure that requires a lateral TSE of +/-1 NM in the initial, intermediate and missed approach segments (MAS) and a lateral TSE of ±0.3 NM in the Final Approach Segment (FAS).

4.5.4.3 RNP APCH LNAV procedure do not rely on ground radioaids and are more accuracy than conventional VOR/DME procedures. Also improve access being aligned in most cases with the runway centre line.

4.5.5 LNAV/VNAV (BARO VNAV) Approaches if analysis determines a benefit

4.5.5.1 Baro-VNAV approach procedures are classified as APV procedures in support of Type A 3D approach operations. They utilize a DA/H and not an MDA/H, and neither a FAF nor a missed approach point (MAPt) is identified. They use obstacle assessment surfaces similar to those for ILS, but based on the specific lateral guidance system.

4.5.5.2 Baro-VNAV procedures are used in association with LNAV-only procedures. The LNAV-only FAF and MAPt are needed to define the lateral areas and to support the lateral guidance but they are not used for the vertical navigation function.

4.5.5.3 Baro-VNAV procedures shall not be authorized with a remote altimeter setting.

4.5.5.4 Providing lateral and vertical guidance, BARO-VNAV approaches increase safety, access and accuracy compare with an RNP APCH LNAV procedure.

4.5.6 Implementation of RNP AR Approaches/Departures if analysis determines a benefit.

4.5.6.1 Implementation of RNP AR procedures extends beyond procedure design in that an authorization process for aircraft operators is necessary to ensure that other critical dependencies and associated airworthiness and operational procedure approvals are complete prior to implementation. Guidance on implementation and operational approval is provided in the PBN Manual.

4.5.6.2 RNP AR APCH is defined as an RNP approach procedure that requires a lateral TSE as low as ±0.1 NM on any segment of the approach procedure. RNP AR APCH procedures are only published where significant operational advantages can be achieved while preserving or improving safety of operation.

4.5.6.3 RNP AR APCH are very useful in mountainous and noise sensitive areas to improve access to the airport through radius to fix RF turns.

4.5.7 Implementation of APV (GLS/LPV) Approaches if analysis determines a benefit

4.5.7.1 GBAS is also refer as LAAS (local area augmentation system), It can be used to achieve accuracy required to CAT I-III and is done by locating 4 receivers on the ground at a precisely -surveyed (centimetre accuracy) positions.

4.5.7.2 The cost of one GBAS ground station is less that the cost of multiple ILSs for an airport. Another advantage of GBAS is that the accuracy enhancement is provided for the whole airport.

4.5.7.3 PBN is one of the tools that supports the airspace optimization concept and should continue to be implemented according to the timelines agreed to for the Region, in conjunction with other concepts in the transition to FRA.

4.5.7.4 PBN concept provide a safe and efficient airspace design for terminal areas. SIDs/STARs are the link to the upper airspace and utilizing CCOs/CDOs provide optimal efficiency.

4.6 Move toward FRA

4.6.1 Given the diversity of the CAR Region airspace, the taskforce will develop a methodology to analyze the level of readiness of each FIR within the region and determine the steps required for Airspace Optimization, including the transition to Free Route Airspace, based on the following concepts:

- **Direct (DCT):** Directs (DCTs) are established at national and regional levels and made available for flight planning (with published conditions of use). DCTs should be considered as **an early iteration of the FRA concept**. DCT operations allow airspace users to optimize flight and fuel planning.

- **User Preferred Routings (UPRs):** User Preferred Routings (UPRs) may allow users to **make a request and gain approval by ANSPs** to deviate from the basic requirements of published ATS route network in order to tailor individual flight's routes to achieve more favorable wind conditions and to meet other company objectives.

- **Free Route Airspace (FRA):** Free Route Airspace is a specified volume of airspace within which **users may freely plan a route** between defined **entry and exit points**, with the possibility to route via intermediate waypoints, without reference to the ATS route network, subject to airspace availability.

  FRA enables airspace users to fly as close as possible to what they consider the optimal trajectory without the constraints of a fixed route network structure.

Note: These definitions are strictly for the purpose of this document.

4.6.2 In order to classify the capability of a particular portion of airspace to move forward with the Airspace Optimization process and the transition to FRA, the following levels will be utilized:

Level	Description
Level A	A portion of airspace which allows tactical DCTs routings, based on request.
Level B	A portion of airspace which allows limited UPRs with possible restrictions.
Level C	A portion of airspace which allows unlimited UPRs without restrictions.
Level D	A portion of airspace which allows FRA.

<table>
<tr><th>Level</th><th>Requirements</th></tr>
<tr><td>Level A</td><td rowspan="4">To be developed</td></tr>
<tr><td>Level B</td></tr>
<tr><td>Level C</td></tr>
<tr><td>Level D</td></tr>
</table>

5. CAR Region Airspace Optimization Implementation Form

5.1 General

5.1.1 An implementation form has been created in order to help States/organizations to determine the level of accomplishment of the airspace optimization concept.

5.2 Description of CAR Region Airspace Optimization Implementation Form

To be developed.

6. Reference Documents

ICAO Reference Documents

1. Performance Based Navigation (PBN) Manual (Doc 9613)
2. Continuous Climb Operations (CCO) Manual (Doc 9993)
3. Continuous Descent Operations (CDO) Manual (Doc 9931)

4. Required navigation Performance Authorization Required (RNP AR) Manual (Doc 9905)
5. Aircraft Operations volume 2- Construction of Visual and Instrument Flight Procedure (Doc 8168)
6. Procedures for Air Navigation Service-Air Traffic Management (Doc 4444)
7. Regional Performance-based Air Navigation Implementation Plan (RPB ANIP) for NAM/CAR Regions.