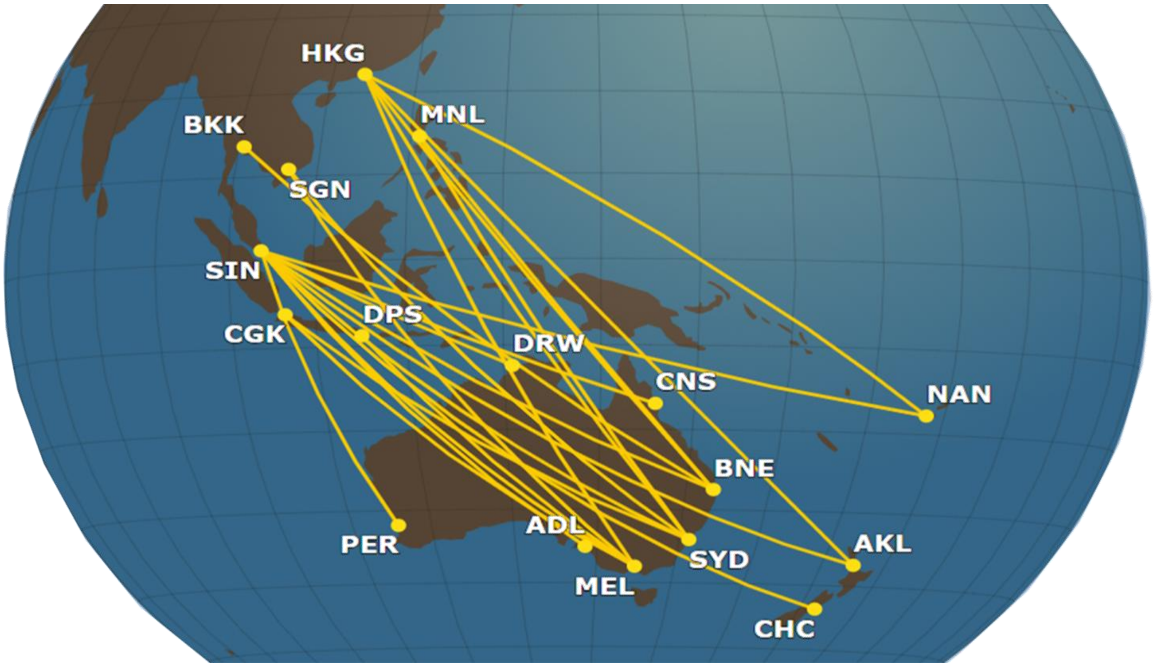


Guidance Material for the Implementation of FRTO in the Asia-Pacific Region

Version 1.0 – 6 July 2026

Compiled by Workstream 4 of the APAC ANSP Committee (AAC)

Contents

Foreword

Introduction

Free Route Operations (FRTO) represents the practical realization of ICAO's goal for user-preferred trajectories as detailed in the ICAO Global Air Navigation Plan (GANP), where the capacity to *enable airspace users to fly their preferred trajectories*[1] is identified as an important Global Plan Initiative.

The implementation of FRTO provides Air Navigation Service Providers (ANSPs) and airspace users with a valuable opportunity to enhance operational efficiency, reduce user costs, and contribute positively to environmental sustainability whilst always maintaining operational safety at the same time. Given the projected air traffic growth in the Asia/Pacific region, FRTO implementation is also regional strategic priority in the APAC Seamless ANS Plan (Version 4.0).

Successful implementation of FRTO demands a step-by-step approach; extensive and broad stakeholder consultation; technology upgrades; appropriate airspace design; procedures for coordination and communication; suitable ATM procedures; cross-border harmonization; and continuous performance monitoring from safety and operational perspectives. Such a step-by-step approach supports mitigating change challenges where FRTO implementation may increase traffic and sector complexity and require appropriate ATM automation tools and controller training.

This guidance material is designed to aid States/Administrations within the ICAO APAC region that are considering the implementation of FRTO. This material is an output of the APAC ANSP Committee (AAC) Workstream Four and draws upon the experiences of States that have already implemented FRTO. It also utilises information provided during the 2024 and 2025 webinars on *Free Route Airspace Implementation in APAC region* organised by the ICAO APAC Regional Sub-Office.

FRTO Concepts

FRTO contributes towards trajectory-based operations (TBO) as a subset within the broader TBO framework. Within FRTO a range of progressively less restrictive flight planning options are available, namely:

- Enhanced or structured direct routings (FRTO-B0/1 – Direct routing (DCT)
- User Preferred Routes (UPRs)
- UPRs with Dynamic Airborne Rerouting Procedures (DARPs)
- Flexible Use of Airspace (FUA)
- Free Route Airspace (FRA)
- Large-scale Cross-border FRA

[1] ICAO Global Air Navigation Plan (GANP) Para 5.2.14

These concepts are more fully explained herein.

References

ICAO Documents

ICAO Global Air Navigation Plan (GANP) Portal, accessed via https://www4.icao.int/ganpportal/

ICAO Global Air Navigation Plan (GANP) Portal – Aviation Safety Block Upgrade (ASBU) Elements, accessed via https://www4.icao.int/ganpportal/ASBU?IDs=84

ICAO Asia/Pacific Seamless ANS Plan, Version 4.0, November 2024

EUROCONTROL Documents

EUROCONTROL FRA – Free Route Airspace, accessed via https://www.eurocontrol.int/concept/free-route-airspace

European Route Network Improvement Plan (ERNIP) - Part 1, accessed via https://www.eurocontrol.int/publication/european-route-network-improvement-plan-ernip-part-1

NM Flight Planning Requirements – Guidelines, accessed via https://www.eurocontrol.int/publication/nm-flight-planning-requirements-guidelines

Glossary

Definitions of Relevant Terms and Concepts

AFUA – Advanced Flexible Use of Airspace
FUA procedures are 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 are continuously exchanged and integrated in real time between the ATM systems.

AIDC – ATS Inter-facility Data Communication
A system which enables ATS units to exchange, via data link, formatted messages containing operational flight data for the purpose of improving the quality and timeliness of the exchange of information between those ATS units.

AIS – Aeronautical information Services
A service established to ensure the flow of information necessary for the safety, regularity, and efficiency of international air navigation.

AOI – Area of Interest
A specific geographic region or airspace segment that an Air Traffic Service (ATS) unit, controller, or system monitors closely due to operational, safety, or security reasons. The AOI represents the portion of airspace where particular attention is required for traffic management, surveillance, or coordination.

ASM – Airspace Management
The process that allows the different needs of all airspace users to be met equitably, ensuring the most efficient use of airspace based on actual needs and avoiding permanent segregation when possible.

ATC – Air Traffic Control
A service provided for the purpose of preventing collisions between aircraft and to expedite and maintain an orderly flow of air traffic. FRA remains subject to ATC oversight.

ATFM – Air Traffic Flow Management
A service that regulates air traffic demand and capacity to ensure the optimum use of airspace and airport capacity. Integrated with ATC planning in FRTO-B2 stages to support cross-border FRA.

ATS – Air Traffic Services
Services provided to ensure safe and efficient air traffic operations, including air traffic control, flight information, and alerting services.

Cross-Border FRA
The extension of Free Route Airspace across multiple Flight Information Regions (FIRs) with harmonized procedures and integrated ATFM/ATC planning, introduced in FRTO-B2, which involves integrated ATFM and ATC planning functions.

CPAR – Conflict Prediction and Resolution
The processes and tools used in air traffic management to detect potential conflicts between aircraft (i.e., situations where aircraft may come too close or violate separation minima) in advance, and to develop and apply appropriate measures to resolve those conflicts, ensuring safe separation and efficient traffic flow.

CWP - Controller Working Position
A designated position within an ATS unit where an air traffic controller performs air traffic control duties. It typically includes all the necessary equipment (radar displays, communication tools, flight data processing) required for controlling air traffic in a specific sector or function.

DARP - Dynamic Airborne Rerouting Procedure
The ability for flight, whilst en-route, to request and be granted a route change (rerouting) by ATC, typically to avoid adverse conditions (e.g. weather, traffic congestion) or to improve efficiency outcomes.

Dynamic Sectorisation
The adjustment of ATC sector boundaries in real time to manage changing traffic demand and complexity, part of FRTO-B1/4 enhancements. This ability to change ATC sectors, by temporary mergers, splits or by opening up a new Controller Working Position (CWP) on the same sector should be a normal part of ATC operations for supervisors managing controller resources due the many factors impacting workload.

Enhanced Conflict Detection / Conformance Monitoring Tools
Advanced systems for monitoring aircraft trajectories and detecting potential conflicts, necessary for implementing FRA safely in FRTO-B1 and B2 stages

FDP – Flight Data Processor
A Flight Data Processor is a computer system or software application used by ATS units to manage, process, and distribute flight data. It supports air traffic controllers by handling flight plan information, coordination messages, and other operational data essential for air traffic management.

FRA - Free Route Airspace
FRA is a specified volume of airspace within which users may freely plan a route between a defined entry point and a defined exit point, with the possibility to route via intermediate (published or unpublished) waypoints, without reference to the ATS route network, subject to airspace availability. Within this airspace, flights remain subject to air traffic control. 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.

FRTO – Free Route Operations
An ICAO ASBU enabled operational concept to facilitate user-preferred trajectories by implementing direct routing, flexible routings, and, ultimately, free route airspace. For APAC, FRTO is staged across ASBU building blocks B0, B1, and B2 in the Asia/Pacific Seamless ANS Plan.

- FRTO-B0/1 to B0/4
  The initial stage of FRTO in the Asia/Pacific Plan, focusing on direct routing, airspace planning, flexible routings, and basic conflict detection and conformance monitoring
- FRTO-B1/1 to B1/7
  The intermediate stage introducing Free Route Airspace, Required Navigation Performance (RNP) routes[2], Advanced FUA and Airspace Management (ASM), Dynamic Sectorisation, Enhanced Conflict Detection Tools and Conformance Monitoring, and Multi-Sector Planner Function
- FRTO-B2/1 to B2/4
  The advanced stage featuring Integrated ATFM and ATC Planning, Dynamic Airspace Configuration, Cross-border FRA, and Enhanced Conflict Resolution Tools

FUA – Flexible Use of Airspace
An airspace management concept based on treating airspace as a continuum (not purely civil or military), enabling dynamic allocation to accommodate all users' needs and optimize airspace usage for both civil and military operations.

GNSS – Global Navigation Satellite System
A satellite-based navigation system that provides autonomous geo-spatial positioning with global coverage. It allows users with GNSS receivers to determine their precise location (latitude, longitude, altitude) anywhere on Earth, at any time, and in any weather conditions.

MONA – Monitoring of Navigation Aids
The systematic and continuous observation, testing, and verification of the performance and accuracy of navigation aids (NAVAIDs) to ensure their reliability, integrity, and availability for safe air navigation.

MSP - Multi-Sector Planner Function
A tool/function enabling coordination across multiple sectors to manage trajectories in Free Route Airspace, included in FRTO-B1 enhancements.

MTCD – Medium-Term Conflict Detection
An automated function in Air Traffic Management (ATM) systems that detects potential conflicts between aircraft well in advance, typically from 10 to 20 minutes ahead, based on predicted flight trajectories.

[2] Whilst this is the text directly from the cited ASBU, it may be better to use the term 'RNP Airspace'. To apply RNP separation, there is a requirement for aircraft to have RNP approvals and for the airspace to be considered RNP airspace. Whilst RNP routes can be approved, this does not allow use of reduced separation standards requiring RNP if one or both aircraft are not planned along the specified route. The benefits of UPRs are reduced for airspace volumes not considered RNP airspace, as legacy separation standards must be applied.

RNP Routes – Required Navigation Performance Routes
Precision Global Navigation Satellite System (GNSS) navigation routes introduced alongside FRA to enhance efficiency and safety in FRTO-B1 stages.

SMS – Safety Management Systems
A systematic, explicit, and comprehensive process for managing safety risks in aviation organizations. It includes organizational structures, accountabilities, policies, and procedures to ensure the safety of operations.

About the Guidance Material

Purpose

This guidance material is intended to assist APAC States/Administrations who wish to start the implementation of free route operations. It is a consolidated document that summarises relevant material from various ICAO documents and portals, along with material produced by experienced international ANSPs such as EUROCONTROL and the FAA.

The guidance material is also intended to provide new entrant airlines an understanding of challenges and lessons learnt from the trial participants and airlines that have long experience in planning and executing UPRs.

Information provided during the 2024 and 2025 webinars on Free Route Airspace Implementation in APAC region organised by the ICAO APAC Regional Sub-Office has also been utilised.

This guidance material is an output of the APAC ANSP Committee (AAC) Workstream Four. Several AAC Workstream Four members who have already implemented FRTO have provided practical implementation case studies. These valuable insights are included in the Performance Measurements, and Case Studies and Best Practices sections later in this document.

Scope

This guidance material is not intended to replace direct review and consideration by States/Administrations and ANSPs of the relevant ICAO documents and provisions, and it does not provide regulatory guidance.

Types of FRTO

Within APAC, and globally, ANSPs and States/Administrations have generally taken a measured and staged approach when moving towards the implementation of FRTO. As highlighted in the ASBU section below, a typical step-by-step path to full user-preferred trajectories might involve the status quo → direct routing → UPRs → free route airspace → large-scale cross-border free route airspace.

More comprehensive descriptions of the ASBU requirements associated with the various types of FRTO are included in the next section.

Direct routings (DCT)

DCT (or strategic direct routing – SDR) enables fixed direct route segments in upper airspace. It is designed for improved efficiency but is not fully flexible like FRA.

DCT includes defined entry/exit points from ATS routes and the use of RNAV waypoints or navigation aids. The suspension of DCT for contingencies like radar failure or ATFM events is relatively straightforward.

DCT initiatives provide a manageable option to start evaluating the potential for more expansive free route operations. They do not require changes to existing team structures or work processes, and controller workload can be managed through the selection of less complex routes/flows and/or limiting initial implementation to hours when traffic demand is lower. Changes to existing ATM system functionalities and alerts are not necessarily required, however in more complex traffic environments ATM systems with functions such as trajectory prediction, route validation, and conflict detection provide enhanced controller support.

The Asia/Pacific Seamless ANS Plan Version 4.0 emphasizes that ATC units should facilitate and manage direct and flexible routings where practicable. DCT routings are considered a practical step towards UPR and full FRTO implementation subsequently by reducing reliance on fixed ATS routes and allowing more efficient point-to-point navigation.

The plan signals to States/Administrations and ANSPs that FRTO implementation is a regional priority and that enabling direct and flexible routing options are key measures to support seamless ANS.

User Preferred Routes (UPRs)

For airspace that is not yet enabled as FRA, UPR represent one of the first steps for more efficient aircraft routing – especially for sector lengths of more than 4 hours.

UPR allows airspace users to choose an optimized route that is not constrained by published ATS routes or waypoints. This route is based on individual flight requirements, including prevailing environmental conditions and the actual aircraft configuration on the day. It seeks to deliver benefits like lower fuel burn, reduced emissions, and increased payload.

UPRs fosters dynamic airspace optimization, allowing routes tailored to day-to-day conditions through helping airspace users to capitalize on various advantages such as:

- Preferential departure/arrival routings
- Avoiding restricted airspace reservations
- Avoiding adverse weather
- Using favourable wind patterns (i.e. taking advantage of strong tailwinds or avoiding strong headwinds)

A UPR may not represent the shortest distance across the ground, however it will represent the most efficient (normally in terms of time and fuel burn) option for that flight.

Even when UPRs are available, the traditional fixed route network may represent the most efficient option for a particular flight on a given day.

UPR implementation places demands on ATM systems capabilities (e.g. for conflict detection, route adherence monitoring, cross-border coordination) and requires ATC personnel and infrastructure to support more complex, dynamic flows. Safety considerations, conflict checking, airspace constraints (e.g. military and danger areas), and other operational restrictions still apply.

The Asia/Pacific Seamless ANS Plan Version 4.0 considers UPRs as a step towards free route operations, and a direct enabler of the APAC region’s move toward more dynamic, flexible routing practices in high-level controlled airspace.

Dynamic Airborne Rerouting Procedures (DARP)

DARP refers to the ability for flight, whilst in-flight, to request and be granted a route change (rerouting) by ATC, typically to avoid adverse conditions (e.g. weather, traffic congestion) or improve efficiency outcomes.

The key factor is that the rerouting is dynamic — i.e. decided or executed during the flight after an evaluation of the actual inflight conditions and updated weather forecasts post-departure, versus the inflight conditions anticipated during the flight planning stage.

DARP involves communication exchanges before any trajectory changes and is not a continuous process during the flight, unlike FRTO. It is subject to approval by the controlling ATC authority and any relevant downstream ATC units, and subject to the normal considerations such as conflict checking, airspace availability, and safety factors.

ICAO DARP procedures are described in the GOLD Doc 10037. The Asia/Pacific Seamless ANS Plan Version 4.0 acknowledges DARP as an enabler for trajectory-based operations within the same context as UPR and FRTO.

Airspace Management (ASM) and Flexible Use of Airspace (FUA)

ASM and FUA are critical enablers of free route operations, rather than being end goals by themselves.

ASM is a process that allows the different needs of all airspace users to be met as equitably as possible. The goal of ASM is to achieve the most efficient use of the airspace based on actual needs and, when possible, the avoidance of permanent airspace segregation.

FUA is an airspace management concept based on the principle that airspace should not be designated as purely civil or military, but as a continuum in which all user requirements are accommodated to the greatest possible extent. Optimizing airspace for both civil and military operations result in widescale benefits, based on the principle “as civil as possible, as military as necessary”.

A basic principle of FUA is that cooperation and coordination between civil and military authorities should be carried out at the strategic, pre-tactical and tactical phases to increase safety and airspace capacity and to improve the efficiency of aircraft operations.

ICAO Doc 10088 highlights the need for advanced-FUA (AFUA) as an enabler of FRA and further details are included below under ASBU element FRTO-B1/3.

The Asia/Pacific Seamless ANS Plan Version 4.0 highlights FUA as a central enabler of seamless air navigation in the region. It highlights advanced FUA, alongside dynamic sectorisation, enhanced conflict detection, and conformance monitoring, as specific enablers of FRA and RNP routes

The plan further notes that FUA is not only a principle, but also a practical requirement embedded in the FRTO ASBU elements and advanced ASM. Its goal is to increase airspace capacity, improve efficiency, and ensure equitable access for civil and military users.

Free Route Airspace (FRA)

Tailoring the EUROCONTROL definition to reflect practices in Asia Pacific, FRA is a specified volume of airspace within which users may freely plan a route between entering and exiting the volume, with the possibility to route via intermediate reporting points (published waypoints or lat/long coordinates), without reference to the ATS route network, subject to airspace availability.

Within this airspace, flights remain subject to air traffic control. 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.

Key factors to note include:

- FRA is limited to specified volumes of airspace (e.g. FIRs, upper airspace, etc.);
- FRA includes defined entry and exit points, and aircraft must adhere to entry/exit conditions of the FRA volume;
- FRA is subject to airspace availability and use depends on coordination, military reservations, other constraints;

- while direct routes are preferred, routing via published or unpublished waypoints is allowed to avoid Special Use Airspaces (SUA), terrain, or constraints; and
- routes within FRA do not need to align with fixed airways or route segments.

The Asia/Pacific Seamless ANS Plan Version 4.0 frames FRA as a progressive, step-by-step implementation process building on structured DCT and UPRs before full FRA. It highlights that cross-border coordination is essential to achieve seamless FRA operations across FIRs. Successful implementation requires technology upgrades, harmonised procedures, and stakeholder training, along with clear publication of intermediate points and airspace limitations.

Large-scale Cross-border FRA

A volume of airspace spanning two or more adjacent Flight Information Regions (FIRs) in which airspace users are permitted to plan and fly their preferred trajectories continuously across FIR boundaries whilst respecting requirements to plan entry, exit, and intermediate reporting points. Such trajectories would not require the use of fixed ATS route networks or mandatory published waypoints at FIR interfaces, subject to airspace availability and coordination between the air navigation service providers involved.

Key factors to note include:

- the available airspace spans multiple FIRs;
- continuous routing across those boundaries is permitted;
- the core features of FRA are retained, i.e. free route planning between entering and exiting adjoining FRAs via intermediate reporting points, that is not constrained by the fixed ATS route network;
- rigid inter-FIR constraints are removed or relaxed; and
- cooperation and harmonization of procedures between the involved ANSPs; and
- supporting technology such as ATS Inter-facility Data Communication (AIDC), are critical enablers.

The next section provides more detailed technical references sourced from the ICAO Global Air Navigation Plan (GANP), the ICAO GANP portal, and the Asia/Pacific Seamless ANS Plan Version 4.0.

FRTO and ICAO ASBUs

Summary of FRTO Related ASBU Elements[3]

FRA is embedded in the ICAO Global Air Navigation Plan (GANP) which includes the global initiative *to enable airspace users to fly their preferred trajectories*. The GANP also calls for regional planning elements to modernize systems on a performance basis to help reach the goal of FRA operations.

FRA is often used interchangeably with "Free Route Operations" (FRTO) and is seen as a flexible/dynamic version of direct routing systems already implemented worldwide.

FRA is a key enabler within ICAO's ASBU methodology, appearing as Block 1-1 in FRTO threads and tied to the TBO concept.

Broadly, the main technical and procedural enablers for the implementation of FRTO are:

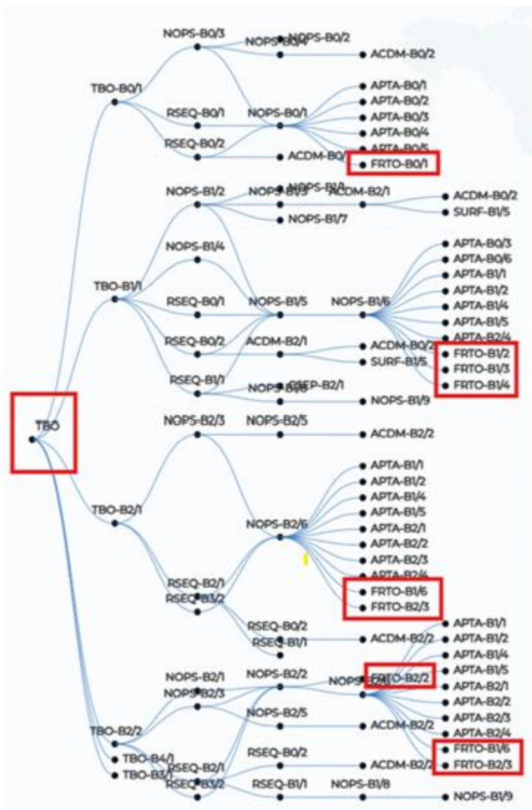
- advanced ATM Systems capable of processing flexible flight plans;
- Safety Management Systems (SMS) embedded into FRA operations;
- advanced Communications, Navigation and Surveillance (CNS) technologies;.
- airspace design and ATC procedures adapted to dynamic route management;
- ATC and airline flight planning systems, and computer flight planning service provider systems (CFPSPs) to manage flexible planning options;
- ATC trajectory prediction/conflict detection and resolution tools that utilise aircraft performance models and ATM surveillance data (e.g. Mode S Downlinked Aircraft Parameters (DAPS),ADS-B, ADS-C);
- Aeronautical Information Service (AIS) publications with clear procedures as what airspace users can expect;
- Digitized information management that supports aircraft operator and pilot decision making (DAIM-B2/2) (e.g. data from monitoring of navigation aids (MONA);
- ATFM upgrades to ensure compatibility with FRA;
- Controller and airspace user training;
- regulatory standards and compliance; and
- performance monitoring.

The ASBU elements related to FRTO that reflect the above points are detailed in the *Operational* section of the ASBU threads accessible via the ICAO GANP Portal.

The TBO tree below illustrates the complex interdependencies of TBO elements and how they integrate with other ASBU elements, showing how each component contributes to the overall TBO concept within the broader ASBU operational vision.

[3] ICAO GANP Portal – ASBU Elements

Fig 1 - ICAO ASBU FRTO Elements and Performance Framework TBO Tree



ELEMENTS

Element ID	Title
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 sectorization
FRTO-B1/5	Enhanced Conflict Detection Tools and Conformance Monitoring
FRTO-B1/6	Multi-Sector Planning
FRTO-B1/7	Trajectory Options Set (TOS)
FRTO-B2/1	Local components of integrated ATFM and ATC Planning function (INAP)
FRTO-B2/2	Local components of Dynamic Airspace Configurations (DAC)
FRTO-B2/3	Large Scale Cross Border Free Route Airspace (FRA)
FRTO-B2/4	Enhanced Conflict Resolution Tools

Expanded details of five key elements have been provided below to illustrate the potential graduated progression of FRTO implementation:

> the status quo → direct routing (FRTO-B0/1) → UPR → free route airspace (FRTO-B1/1) → large-scale cross-border free route airspace (FRTO-B2/3).

ASBU Block 0

En-route trajectories are enhanced by using more direct routings, and collaborative airspace management process and tools. Air Traffic Control Officers (ATCOs) are assisted by tools for the conflict identification and conformance monitoring.

FRTO-B0/1 Direct Routing (DCT) – direct routings are established with the aim of providing airspace users with additional flight planning route options on a larger scale across FIRs such that overall planned leg distances are reduced in comparison with the fixed route network. 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 Free Route Airspace (FRA) concept. Direct routing operations allow airspace users to optimize flight and fuel planning.

DCTs could be implemented in a limited way e.g.:

- time constraints (fixed or depending on traffic/availability);
- traffic constraints (based on flow and/or level of traffic);
- flight level limitations;
- lateral constraints; and
- specified airspace entry/exit conditions

The extension of direct routings within and across FIR boundaries also requires network and ANSP ground system upgrades for airspace management and flight data processing.

The following procedures and process might need to be considered:

- identify the direct routing airspace volume (lateral and vertical) and applicable timing, if flexible Special Use Airspace (SUA) is used;
- direct routings may co-exist with ATS route structure;
- identify direct routing airspace entry and exit points;
- ensure direct routing horizontal and vertical connectivity to the fixed route system beyond FRA;
- ATFM systems able to take into account direct routing procedures;
- adapt the Letter of Agreement (LoA) with adjacent ATS units;
- publish relevant data for direct routing in the AIP;
- airspace management procedure for the implementation of direct routings;
- ATC procedures to cover direct routing co-ordination and transfer of control, trajectory change in direct routing;
- airspace configuration; and
- Medium Term Conflict Detection (MTCD) and conflict probe systems.

The ATM system upgrades of Flight Data Processors (FDP) and CWP, if required, are related to:

- upgrade of network flight planning and ASM/ATFM system to support DCTs;
- direct routing clearances;
- rerouting capabilities in cases the direct routing traverses airspace utilized by the military;
- differentiation between different traffic type of airspaces;
- direct routing capability beyond the controller’s Area of Responsibility (AoR);
- calculation of 4D trajectory within an Area of Interest (AoI[4]); and

[4] AOI should be capable of processing aircraft whose trajectory is increased laterally or vertically by factors such as weather deviations, offsets and block levels that would otherwise not infringe the

- editing function for 4D trajectories

FRTO-B0/2 Airspace planning and Flexible Use of Airspace (FUA) – the establishment of FUA processes and improved data exchange between civil and military stakeholders by automation enables a more efficient use of airspace based on transparency whilst still giving due regard to national security needs.

The deployment of automated ASM support systems to manage airspace reservations based on airspace user needs, and resulting from civil-military collaborative decision-making process, allows more flexibility according to the need of the airspace user.

Automated ASM support systems improve airspace management processes and flexible airspace planning including time horizon specifications in all flight phases (strategic, pre-tactical and tactical) by providing mutual visibility on civil and military requirements. They also support flexible airspace planning according to civil and military ANSPs and airspace user requirements, including permitting cross-border operations and use of segregated operation areas, regardless of airspace boundaries.

ASBU Block 1

Block 1 introduces the initial steps towards trajectory-based operations by the enhancement of FRTO B0 processes and system support or the deployment of new processes and system support where necessary.

FRTO-B1/1 Free Route Airspace (FRA) – the FRA concept brings significant flight efficiency benefits and a choice of user preferred routes to airspace users. The FRA concept brings increased flight predictability, reduced uncertainty for the ATM network function, which in turn can lead to potential capacity increases for ATM, which will also benefit the user.

The extension of FRA within and across the FIR boundaries also requires upgrades of the ATM network function system and the ANSPs ground system for airspace management and flight data processing.

The following procedures and processes may need to be considered in addition to the Block 0 considerations:

- FRA entry and exit points, arrival transition point and departure transition point, as well as intermediate reporting points;
- processing lat/long points in place of 5LNC waypoints
- charts for FRA operations; and

AOI. e.g. the aircraft's nominal route and level does not enter the AOI, however being cleared to deviate up to 50NM left of route does infringe the AOI - the ATM system must be able to process this.

- ATC procedures to cover free route co-ordination and transfer of control, trajectory change in a free route environment,

Upgrades of ATM systems for flight data processing and CWP in addition to Block 0 capabilities, if required, are related to:

- coordination point management for FRA;
- coordination with military agencies; and
- enhance conflict management and controller Human-Machine Interface (HMI) functions to support Conflict Prediction and Resolution (CPAR).

FRTO-B1/3 Advanced Flexible Use of Airspace (FUA) – ICAO Doc 10088 discusses FUA and includes concepts that support the advanced or matured form of FUA (AFUA) described in this ASBU element.

The key enablers for AFUA detailed in Doc 10088 include:

- Civil–Military Coordination at All Phases: Strategic, pre-tactical, and tactical cooperation to dynamically allocate and manage airspace;
- integrated Systems and Information Sharing: Interoperable civil/military systems with real-time data exchange on airspace status and missions;
- ASM, ATFM and ATS Integration: Airspace management, flow management, and air traffic services working together to support flexible operations;
- Dynamic Procedures and Allocation: Ability to activate, deactivate, or reconfigure reserved airspace quickly based on operational needs;
- Governance and Regulatory Framework: National policies, joint civil-military bodies, and legal structures that authorize and oversee AFUA;
- Performance Monitoring: Metrics and KPIs to evaluate AFUA effectiveness and drive continuous improvement; and
- Stakeholder Engagement: Regular consultation with airspace users to build trust and ensure smooth implementation.

ASBU Block 2

Block 2 includes further steps towards trajectory-based operations by the enhancement of FRTO B1 processes and system support, or the deployment of new processes and system support where necessary.

FRTO-B2/3 Large Scale Cross Border FRA – the most important operational improvement is related to the large-scale cross-border Free Route Airspace (FRA) as the continuation of FRTO B1. Large-scale cross-border FRA (e.g. Continental operations) are envisaged to be widely deployed, except where structure provides for efficient performance-based routings into and out of high-density airspace.

Large-scale cross-border FRA operations based on regional implementation can provide even greater freedom and benefits to airspace users, enabling them to fly according to their own business models and supporting the transition towards full trajectory-based operations. Large-scale cross-border FRA will enhance flight predictability and reduce uncertainty, which in turn can lead to potential capacity increases for ATM, contributing to higher operational efficiency, better utilisation of shared airspace, and continued advancement toward full trajectory-based operations.

In large-scale cross-border FRA operations, the FRA concept is applied across a large-scale geographical area and typically changes from State/Administration implementation to regional implementation.

The initial implementation of FRA comes with certain limitations e.g. FL, dimensions, timing, functions and tools, latitude/longitude use as a significant point etc. Large-scale cross-border operations of FRA will ensure that these limitations are removed and no longer required, leading to seamless operations in a large volume of airspace crossing FIR boundaries and/or areas of responsibility.

FRTO in the APAC Seamless ANS Plan (Version 4.0)

The Asia-Pacific Seamless ANS Plan Version 4.0 reinforces the concept of implementing FRTO as a staged process that begins with direct and flexible routings, matures into FRA with advanced FUA/ASM and dynamic sectorisation, and culminates in large-scale cross-border FRA supported by integrated ATFM/ATC planning and dynamic airspace configuration.

The progressive FRTO path for the Asia-Pacific region is underpinned by:

- **Flexible Use of Airspace (FUA):** Embedded across FRTO stages, requiring civil/military coordination to maximize available airspace for free routing.
- **Dynamic Airspace Management:** Moving from static route structures to dynamically configured airspace that supports user-preferred trajectories.
- **Integrated ATFM/ATC Planning:** Necessary to handle large-scale cross-border FRA, ensuring seamless traffic flow and conflict resolution.
- **Progressive Technology Upgrades:** Enhanced conflict detection/conformance monitoring, dynamic sectorisation and multi-sector planner functions are enablers for FRA.
- **Regional Harmonization:** Cross-border FRA requires harmonized procedures and data sharing across FIRs.

In summary, the GANP and APAC Seamless ANS Plan both highlight the relevant ASBU element needed to progressively implement FRTO from Block 0 through to Block 2:

- ➢ FRTO B0 – Preparation stage (direct/flexible routes) – Direct routing, flexible routings, basic conflict detection

- FRTO B1 – Introduction of FRA with supporting systems – Free Route Airspace, RNP routes, advanced FUA/ASM, dynamic sectorisation, enhanced conflict detection
- FRTO B2 – Expansion to large-scale cross-border FRA – Integrated ATFM/ATC planning, dynamic airspace configuration, large-scale cross-border FRA, enhanced conflict resolution

Operational Trial Guidelines

These guidelines provide a structured framework for the planning, safety assessment, conduct of operational trials, and evaluation of outcomes in the implementation of DCTs, UPRs, and FRA in pursuit of FRTO. They are intended to support ANSPs and (where applicable) States/Administrations, and other stakeholders, and the guidance is aligned with ICAO SARPs, ASBU modules, and other objectives (e.g. operational, environmental).

The shared experiences of regional ANSPs that have already undertaken trials and/or reached business as usual implementation of FTRO to varying levels of maturity have been utilised. EUROCONTROL guidance material has also been utilised where appropriate.

For ANSPs with no experience of FRTO, the suggested approach is based on a step-by-step path to full user-preferred free-route trajectories:

> the status quo → direct routing → UPRs (including cross-border UPRs) → free route airspace → large-scale cross-border free route airspace

Planning and preparation

Successful implementation of FRTO elements requires coordinated planning across multiple dimensions.

Key considerations include regulatory alignment, early stakeholder engagement, and phased implementation.

Creation of a project team or steering committee would support well-structured change management.

Regulatory Framework & Policy Alignment

- Review national regulations and operational polices to determine permissibility of flexible routing options and identify any constraints that will need to be addressed through regulatory change/reforms.
    - Specifically review existing regulations and operational procedures to confirm regulatory and system compatibility with:
        - direct routing provisions;
        - latitude/longitude trajectory planning;
        - PBN standards;
        - aircraft equipage requirements; and
        - flight planning & ATS/AIDC messaging requirements.
- Align implementation with ICAO Annex 11, Doc 4444, ASBU FRTO threads, and the ICAO APAC Seamless ANS Plan, Version 4.0.
- Ensure local regulator approval and assess ICAO PfA requirements if implementation over High Seas is planned.
- Evaluate alignment of the planned operations with States'/Administrations' commitments and policies regarding aviation strategy; regional connectivity and cooperation; and climate and sustainability goals.

- Define FRA volume, entry/exit points, cross-border implications.
- Conduct system and flight plan validation tests well ahead of implementation; involve neighbouring States/Administrations early in the process and ensure draft AIS publications are published at least two AIRAC cycles before implementation.

Stakeholder Engagement

- Engage early with the State regulator; local airlines; regional and international airlines through IATA; the ATCO workforce and their representative associations; and military authorities.
- Early engagement assists with identifying:
    - areas/routes that will benefit most from flexible routing options;
    - potential constraints;
    - airline equipage decisions/fleet considerations that may impact the ability to utilise free routing options;
    - airline preferences for city-pair trials;
    - potential factors that need to be included in the safety case/risk analysis process;
    - inputs into the cost-benefit analysis process; and
    - definition of priority rules (e.g. if there is a confliction who has priority for a level).
- Develop a plan for required regional coordination, e.g. neighbouring FIRs that will be impacted and/or are possible collaboration partners.
- Identify communication/engagement strategy with relevant regional forums (e.g. AAC, ICAO groups).
- Establish consultation mechanisms such as workshops/user forums, simulation exercises.

Phased Approach to Implementation

- One common approach is to begin with paper trials and simulation to assess traffic complexity and controller workload before moving to controlled operational trials and day-to-day/business as usual implementation.
- Recommended phases: Data and gap analysis → Paper/synthetic trials → Limited scope trials → Expanded scope → Full FRA environment.
    - Limited scope may include:
        - restricted hours of operation;
        - specified altitude bands;
        - specified lateral boundaries within an area of responsibility;
        - restricted to within one area of responsibility prior, to cross boundary operations;
        - specific city pairs and/or designated trial flights; and
        - suitably equipped aircraft.
- Limited scope operations allow ATCOs and airspace users to adjust to the new operating environment and identify potential issues at an early stage.

- Constraints can be progressively relaxed in accordance with reaching milestones etc. identified during the safety case/risk analysis phase.

Safety Risk Assessment

Safety assurance processes consistent with ICAO safety management principles shall underpin FRTO implementation. Changes to ATS operations require systematic safety assessment in accordance with ICAO Annex 11 and the Safety Management Manual (Doc 9859).

Structured Safety Risk Management

- Conduct Safety Risk Assessments (SRA) at each implementation stage in accordance with organisation's SMS.
- Define the criteria or metrics used to judge acceptability (quantitative or qualitative).
- Define explicit safety objectives, e.g. target level of safety, acceptable risk thresholds.
- Define how safety performance will be monitored during the operation
- Describe the system, operation, or change being assessed.
- Identify and mitigate operational hazards and risks such as traffic congestion points, cross-border coordination, availability of levels, special use and restricted airspace, and contingencies.
    - Include diagrams/maps of airspace, route structures, entry/exit points.
    - Explain how the change differs from current operations.
    - identify hazards associated with the operational change.
    - Describe barriers and controls for each hazard.
    - Include technical, procedural, and training mitigations.
- Define the require milestones for progression to the next phase of the trial, including the transition to permanent day-to-day operations.
- Define actions if safety thresholds are exceeded (e.g., suspension of trial) **and** how decisions will be made and communicated.

Conflict Detection and Safety Nets

- Common ATM automation functions deployed before the rollout of FRTO include:
    - Flight plan conflict function/warning;
    - Medium-term conflict detection (MTCD) and long-term conflict detection (LTCD) with resolution advisories;
    - Other Tactical Controller Tools (TCT)
    - Route and altitude adherence/deviation monitoring; and
    - Danger/restricted area infringement warning

Human Factors and Training

- ATCOs should undergo simulation-based training that includes new procedures and coordination requirements; any potential conflict hotspots and varied conflict points not normally seen with fixed routes; contingency management; and use of any new automation or other ATM tools.
- Controller workload should be monitored during trials and subsequent live operations via a continuous feedback loop that facilitates quick adaptation in the event of issues or unanticipated (unmitigated) risks being encountered.
- A simple safety and risk assessment framework is included as Table 1 below:

Table 1: Safety Risk Assessment Framework

Risk Area	**Potential Hazards**	**Mitigation Measures**
Traffic Complexity	Congestion at conflict points Conflict points more varied that those produced by fixed routes	Phased route introduction, ATCO training
Separation Assurance	Loss of separation	Flight plan conflict function/warning Medium-term and long-range conflict detection and resolution
Human Factors	Controller workload/vigilance	Simulation, training, workload distribution
Cross-Border Operations	Coordination breakdown Near-boundary coordination challenges	LOAs, AIDC, and Coordination alerting function

Conduct of operational trials

Operational trials provide the bridge between planning and full-scale implementation. They validate concepts, tools, and procedures under live traffic conditions.

Trial Objectives

- Validate safety, efficiency, and environmental benefits.
- Assess impact on workload, coordination, and compliance.
- Transition the trial into business-as-usual operations.

Trial Design and Execution

- The trial design and execution should be finalised during the Planning and Preparation phase.
- The trial should only commence once:
    - Regulatory frameworks are in place and approval has been given;
    - the safety and risk assessment process has been satisfactorily completed;
    - all training, automation, and coordination requirements have been completed in accordance with the project timeline;
    - the relevant trial information (e.g. rules, restrictions, constraints, parameters, contact information etc.) has been promulgated via AIP SUP/NOTAM; and

    - the trial should only progress to the next phase once all identified milestones have been achieved and a post-trial analysis of its safety and effectiveness has been completed.
- The trial should be for a defined time period with a clear progression pathway (timeline and required milestones) to permanent FRTO.

Sample Operational Trial Flow for DCT/UPR/FRA/FRTO

This flow provides a high-level example of a possible structured protocol for planning, executing, and evaluating operational trials for FRTO including DCT, UPR, FRA (based on EUROCONTROL documents)

1. Purpose & Scope

- State the intent of the trial (validate safety, efficiency, capacity, environmental and operational feasibility of FRTO/FRA/UPR/DCT).
- Define the airspace volumes (FIR/sector, vertical limits), time windows (H24 / off-peak), participating operators, traffic samples, and excluded operations.
- Specify trial type:(live, operational trial, paper only) and conditions of trial (e.g. limited hours, limited altitude band, simulation) based on trial objectives and operational constraints.

2. Definitions & Acronyms

- Provide agreed definitions for all relevant terms/concepts.

3. Regulatory & Governance

- Reference national regulations, airspace policy, and regional planning guidelines (e.g., APAC Seamless ANS Plan).
- Identify required approvals (regulator, military).
- Consider establishing a trial steering committee and/or an operations working group.

4. Trial Objectives

- Define measurable objectives and performance indicators, e.g. reductions in flight times, fuel burn, or controller workload, and no increase in safety occurrences.

5. Trial Design

- Phasing: e.g. Phase 1: DCT → Phase 2: UPR → Phase 3: FRA (domestic) → Phase 4 FRA (large-scale cross-border).
- Define time windows, sectors, lateral boundaries, vertical limits, applicable routings.
- Set traffic selection, equipage requirements, sample sizes.
- Define FRA entry/exit and intermediate points and publication method.

- Specify eligibility criteria.

6. Operational Concepts (By Mode – DCT, UPR, FRA)

- **Direct Routing** – fixed direct segments enabling route shortening within defined corridors. State conditions, suspension criteria.
- **User Preferred Routes** – airline-proposed routes optimized for winds/fuel/time, subject to ATC approval. State submission timelines, constraints, acceptance parameters
- **Free Route Airspace** – free planning between defined entry and exit points with optional intermediate points, without reference to ATS route network. State FRA rules, cross-border procedures, contingency plans.

7. Systems Readiness & Training

- FDPS/ATC Tools: trajectory prediction, conflict detection, conformance monitoring.
- Operator & Flight Planning Systems: flight planning and submission, wind/temperature models, cost index policy.
- AIS/AIM: publication processes.
- Training: controller, dispatcher/flight crew, military coordination.

8. Safety Case & Risk Management

- Identify hazards, conduct risk assessments, define barriers and mitigations, monitoring plan, safety performance indicators, trigger thresholds and actions.

9. Operational Procedures

- UPR submission, review and approval process (although this should ideally be 'file-and-fly' and not require having a UPR reviewed ahead of time)
- FRA availability / non-availability promulgation
- management of ATFM measures
- coordination with adjacent FIRs
- prioritization policy, clearance phraseology, vectoring policy, altitude changes, reroutes
- Day of Ops and Post-Ops monitoring and review, data capture check, corrective actions.

10. Suspension & Contingency

- Define clear conditions to suspend the trial or revert to fixed ATS routes, including notification and recovery procedures.

11. Data Collection Plan

- Define data sources, sampling and controls, data fields, data quality and confidentiality arrangements.

12. Key Performance Indicators (KPIs)

- Efficiency – time, fuel, CO_2,
- Safety – LOS, TCAS RA, Breakdown of Coordination,
- Service Quality – tactical interventions per flight,
- Predictability – CTA/ETA adherence,
- Human Performance – controller workload, pilot and dispatcher feedback.

13. Analysis & Success Criteria

- Define methods and thresholds for each KPI, along with success criteria.

14. Communications & Publication

- Pre-trial Publication – AIP updates, pilot/dispatcher notices, ATCO briefings and training materials
- Operational Messaging: NOTAM, local unit orders
- Stakeholder Engagement: Webinars, Q&A, dedicated contact channel.

15. Cross-Border Coordination (if applicable)

- joint design of entry/exit/intermediate points
- harmonised procedures and data sets
- Letter of Coordination Agreements between ANSPs
- AIDC and manual coordination arrangements,
- common contingency and suspension criteria and communication protocols
- joint performance monitoring and data exchange agreements.

16. Post-Trial Transition Plan

- trial analysis, report and assessment for safety and effectiveness;
- decision gates: continue / scale / modify / terminate;
- regulatory adoption steps, AIP requirements for permanent implementation, training updates, system changes; and
- lessons learned: structured capture and incorporation into SOPs and systems.

Outcomes and Performance Monitoring

As the trial progresses through each phase, outcomes should be assessed across safety, efficiency, and environmental dimensions. The lessons learned will determine the permanent procedures once the trial transitions into business-as-usual' for regular operations.

The assessment of trial effectiveness can utilise both quantitative and qualitative metrics (e.g. ATCO, dispatcher, flight crew feedback).

Performance Monitoring

- Define metrics for fuel/time savings, CO_2 reduction, workload, safety, and compliance.
- Collect trial data systematically and review with stakeholders.
- Publish trial outcomes through ICAO regional platforms.
- Note that track mile reduction is not necessarily a useful metric for FRTO. As stated above, a flight utilising a flexible route may cover more track miles than the comparable fixed route but spend less time in the air and consume less fuel/generate fewer emissions through avoidance of strong headwinds or utilisation of strong tailwinds.
- A simple performance measurement table is included as Table 2 below:

Table 2: Example of Performance Measurement Criteria

Performance Area	**Performance Indicator**	**Measurement Method**
Operational Efficiency	Flight time and/or fuel reduction	Compare planned vs. flown trajectories
Environmental Benefit	CO_2 savings (tonnes)	Fuel burn analysis × ICAO emissions factor
Safety	Separation minima violations	Safety reports, controller feedback,
Human Factors	ATCO workload feedback	Post-trial surveys & simulation debriefs

Performance Measurements

Methodologies

Pros and Cons of the SEA-O FRTO Trial – from the Airspace User's Perspective

Airlines that participated in the SEA-O FRTO trial from 5 August 2024 to 31 October 2025 provided feedback of Pros and Cons for the consideration of other Airspace Users (AU) that are implementing FRO into their network. They are as follows.

Pros:

- Efficient routes – the availability of UPR planning provides a broad range of options to design the most cost and time-efficient routes and enables an enhanced level of predictability for planning, particularly related to fuel loading and management.
- Benefits realisation – executing UPRs for extended distances in greater volumes of airspace provides tangible benefits for the AU.
- Weather and volcano avoidance – UPR planning permits better management of diversions around airspace disruptions such that the most efficient solution for the remainder of the flight can be planned and executed.

Cons:

- Limited city-pairs – limiting options to FPL UPRs between cities obviously reduces potential benefits realisation. Complete and unconstrained Free Route Airspace (FRA) remains the priority goal.
- Manual FPL requirements – UPR flight planning should be adopted as business as usual and not require special additional FPL annotations or parallel manual coordination (eg: email)
- Ongoing FPL restrictions – the less operational restrictions required by ATC for designing and planning UPRs, the better. AUs will benefit from working closely with ANSPs to introduce effective change management for overcoming hurdles of residual restrictions.
- Winds not always conducive to UPR planning – some city-pairs do not yield anticipated benefits due their localities in relation to each other and prevailing winds. It is sometime easier and as efficient to plan and fly the published fixed route.
- High terrain constrains some route options – requirements of procedures for managing cabin decompression events means flight over high terrain is constrained which may alter what was identified as the most efficient UPR design.
- Distance of UPR flight – the requirement to reach minimum flight levels before a UPR can be executed and the extended starting point of STARs at some locations reduces the distance available for the UPR segment and therefore reduces realisation of potential benefits.

Tracking airline benefits is not solely capturing and calculating fuel burn data for a UPR. Benefits may also be realised in areas such as optimising payloads based on expected fuel management, or better network performance and customer satisfaction through time efficiencies.

When actual fuel burn data is analysed, the calculation of savings of CO_2 emissions is achieved by measuring fuel consumed and applying a multiplier of 3.16, which is the ICAO CORSIA CO2 emissions factor.

Flight planning also does not always track fuel savings on a flight-by-flight basis, instead at times uses modelling capability built into the flight planning system to measure potential savings. For comparison to UPR design, specific fixed routes are selected that give a reasonable spread of routes for the system to choose. For analysis the most efficient fixed route is compared with the UPR results.

Modelling and/or measuring fuel saving requires a separate flight plan to be created for comparison; this flight plan would never be used which means planner workload is higher for those comparisons.

For the SEA-O FRTO trial, participating airlines used several different methods and target periods to gain best indication of overall benefits. These included:

- Seasonal measurement as some periods of the year have strong jetstream wind patterns providing significantly higher benefits than those when prevailing winds are weak and fixed routes are an equal an easier option.
- Averaging over extended periods (eg: 1-3 years) to provide an average benefits yield (in one trial case 1.5-2%) taking into account all seasons.
- Monthly calculations to provide better comparison of seasonal affects to support decision-making on when to prioritise UPR flight planning.
- City-pair / aircraft type analysis to support decision making on which aircraft are most efficient for which route.

Pros and Cons of the SEA-O FRTO Trial - from the ANSP's Perspective

Pros:

- Expansion of Free-Route Airspace – supports trajectory optimisation under Trajectory Based Operations
- Seamless FIR boundaries – benefitting from automated coordination between units and potentially relieve congestion at some fixed waypoints.

Cons:

- Limited utilisation by some airlines on some city-pairs – resulting in the effort to accommodate UPR not being commensurate with the benefits realised. Detailed prior analysis required to identify city-pairs with the greatest potential for benefits.
- Lack of ATM system automation to support broader expansion – ATM automation tools required to support controller workload for FRTO to expand
- Change management challenges – FRTO is a significant shift from airspace designed with fixed routes and known crossing points.
- Incorrect flight planning by airlines (e.g. use of STAR waypoints in FPLs, leading to misidentification as arrivals by ATM systems) – ANSPs need to provide thorough briefing to airspace users on permitted flight planning waypoints.

Case Studies and Best Practices

Airservices Australia

Early History

Airservices Australia has offered Free Route Trajectory Operations in Australian Administered Airspace since the 1990's, initially in the form of Flex Tracks between Sydney and the US West Coast and then as User Preferred Routes (UPRs). In 2003, Flex Tracks commenced from Dubai in the Middle East and Brisbane and in time included Sydney and Melbourne. In 2005, the Australian Organised Track Structure (AUSOTS) commenced producing additional Flex Tracks in both directions between Southeast Asia and Brisbane, Sydney and Melbourne. Since then, additional Flex Tracks were created between other city pairs including Brisbane and Perth.

Low Density Oceanic Airspace

Airservices Australia began a phased implementation of User Preferred Routes in Oceanic Airspace, initially to replace Flex Tracks between Sydney and the US West Coast. Australia's airspace over the Indian and Pacific Oceans are typically low traffic density environments compared with Oceanic Airspace in the North Atlantic or in the Bay of Bengal and provide the ideal operational environment to trial initiatives to enhance services.

In low density Oceanic Airspace, Airservices engaged with some neighbouring ANSPs to enable flexible boundary crossings at lat/longs rather than fixed waypoints. These initiatives have delivered cost benefits to operators by way of fuel savings. Typically, flights in this airspace are operating routes between Australia and the Americas or Australia and the Middle East and Africa and have flights times of around 12-15 hours. These flexible routing options have made a significant difference in the fuel required to be carried and made city pairs such as Dallas Fort-Worth to Sydney and Dubai to Auckland possible for aircraft operating near their range limits. UPRs were also made available to short-haul international flights operating between Australia and the Pacific Islands.

Airservices' Brisbane FIR boundary with Auckland FIR has a higher traffic density with Trans-Tasman traffic currently accounting for approximately 25% of Airservices' International FIR boundary crossings. Airservices and Airways New Zealand enabled lat/long crossings in the early 2000's when ATM System automation was achieved on both sides. Initially UPRs across the Tasman Sea were available between Melbourne-Auckland and Perth-Auckland city pairs as well as any other flights to Auckland that overflew Melbourne (e.g. from Adelaide). Similarly, a flight from Singapore to Auckland could flight plan a route using a Singapore-Melbourne Flex Track and then transition to a UPR at Melbourne to cross the Tasman Sea to Auckland and vice-versa.

In 2015, the city pair Perth-Auckland was expanded to include Perth-Any NZ port, whilst in 2016, Melbourne-Auckland city pair was similarly increased to include Melbourne-Any NZ port. In 2019, trans-Tasman UPRs were expanded again and permitted UPRs between all ports except for flights between Any New Zealand Port and Sydney, Brisbane, Gold Coast and Sunshine Coast, and other tracking restrictions were eased.

Flex Tracks between Australia and the Middle East which were previously published across the Australian Continent and extended right out across the Indian Ocean. In 2019 these were terminated at the boundary between continental and oceanic airspace and UPRs replaced this portion of the Flex Tracks across the Indian Ocean.

During the COVID-19 pandemic when air traffic essentially dried-up, Airservices temporarily removed all remaining UPR constraints in the Trans-Tasman to provide the few flights operating with as much relief as possible. In 2023, these changes were permanently incorporated.

<u>Continental Airspace</u>

During the COVID-19 pandemic, air traffic in Australia abruptly diminished following the closure of international borders. Further, domestic air traffic dropped considerably as well following the closure of State/Territory borders within Australia. Consequently, traffic which previously flew Flex Tracks either stopped entirely, or for the few flights that remained, schedules changed so significantly that they fell outside the validity periods of existing Flex Tracks. Airservices temporarily replaced all Flex Tracks with User Preferred Routes across the Australian Continent, again to provide the few remaining flights with as much relief as possible.

As State/Territory borders opened and closed, domestically airlines sought opportunities to operate city pairs previously unserved as passengers sought travel opportunities which were very limited. This had its own complications as often existing route structures did not provide efficient tracking options, and thus UPRs largely resolved this issue, however the increase in traffic volume was quite slow. Similarly, the return of international traffic was very sluggish. This had the effect that the traffic increase was essentially drip-fed to ATCOs with airlines continuing to operate on UPRs across the continent.

Periodically, risk assessments were completed to determine whether a return to Flex Tracks was required, however with the gradual way in which the traffic returned, ATCOs got used to processing aircraft on UPRs and ultimately in 2023, UPRs across the Australian Continent were permanently adopted.

This resulted in the UPR ruleset being completely re-written to create time activated UPR exclusion zones around the high-traffic density areas on Australia's East Coast colloquially known as the 'J Curve' (Cairns-Brisbane-Sydney-Melbourne-Adelaide) and North of Perth in Western Australia. In these areas where additional planning options are desired, airlines can request direct (DCT) route segments between published waypoints on different air routes and following a satisfactory risk assessment these are added to the list of approved DCT segments.

High Density Oceanic Airspace

The airspace between the Australian Continent and Indonesia, whilst Oceanic, has a far higher traffic density than the Indian and Pacific Oceans. The area varies between approx. 100-500NM in distance where aircraft transition between the Australian Continent with full VHF communications and ADS-B surveillance, to Oceanic Airspace with either CPDLC or HF communications and only ADS-C surveillance for those equipped, to Indonesian Airspace with full VHF communications and ADS-B surveillance. The Australia-Indonesia FIR boundaries are also the busiest international boundaries Airservices has. For the purposes of FRTO, this airspace has typically been subject to the Continental Airspace ruleset, with the added complexity for ATCOs of no VHF communications or ADS-B surveillance.

Cross boundary flexible routing operations in this airspace bordering Indonesia have been discussed at our highly productive and successful operational bilateral meetings (AUSINDO) for some years prior to COVID. At the 2023 AUSINDO meeting, a dedicated working group was established between respective operational specialists to progress the delivery of a trial.

The establishment of the ICAO AAC and associated workstreams provided Airservices and AirNav Indonesia an opportunity to deliver the work in a regional setting with other ANSPs. The identified ANSPs collaborated to establish the principles of the trial including opportunities for airline operators. The geographical nature of our boundary coupled with the other ANSPs participating in the trial meant that all identified flights in the initial phase would transit the Australian-Indonesian airspace boundary at some point. As a result, it was dependent on our agreed limits as to the number of flights that could participate in the first phase of the trial.

Due to variances in operating environments and technical capabilities of the respective ATM systems along the Jakarta/Melbourne and Ujung Pandang/ Brisbane FIRs, ATCOs were only willing to accept an average of one flight every 45mins over a 24-hour period along the entire boundary.

Both service providers were in agreement to explore city-pairs that offered participating carriers a wide range of flight paths. An analysis of all boundary crossings determined a shortlist of suitable flights across the participating carriers. The analysis of the suitable flights included an average boundary crossing time (calculated over a ten day period using historical data). A formal risk assessment was conducted with representatives from all FIRs including Flight Data Coordinators to capture all relevant risks associated with implementation of the trial. This was part of a larger consultation effort with impacted ATCOs to ensure buy-in across the operational areas. Agreed and aligned communications to impacted staff was part of the project plan and considerable effort was made to hear from ATCOs on matters that may lead to resistance.

The delivery of the trial included the development of appropriate documentation to provide governance to this trial. Operational procedures were collectively agreed and developed. Importantly, opportunities for ATCOs to provide feedback throughout the trial were provided and the feedback was considered in regular reviews.

In addition to seeking the critical operator feedback to the trial, Airservices and AirNav routinely sought to provide the ATCO operational context and observations. This included broader take up of UPRs and analysis of the fuel savings from the selected city pairs. This analysis was exceptionally beneficial when plans to expand the trial emerged.

Assessing the learnings from the initial phase included a realisation that limits existed along the Melbourne/Jakarta boundary due to the absence of automated electronic coordination. The reliance on voice coordination and the procedural defences to maintain safety severely limited the opportunity to expand the set of flights along this part of the Australia-Indonesia boundary.

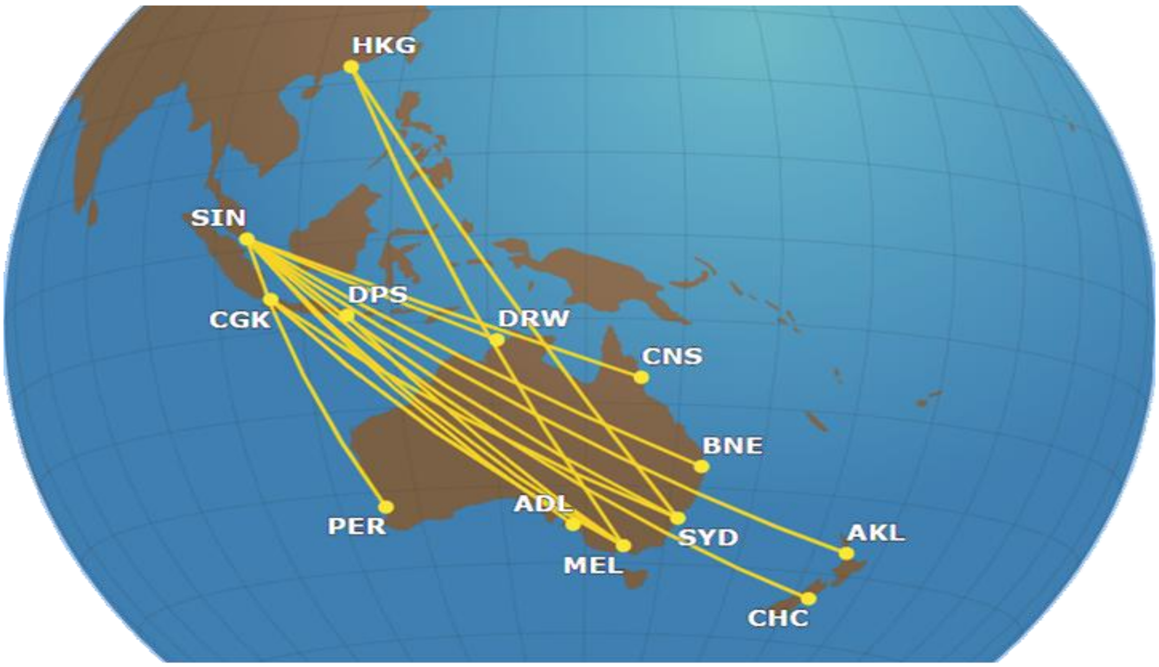
The review of the first phase also demonstrated that some sectors along the Brisbane/Ujung boundary were not receiving flights in the trial and there was opportunity explore city pairs that would increase exposure to these ATCOs through this airspace. This was made even more possible with the inclusion of other neighbouring ANSPs in the trial. Specifically. this opened up city pairs to/from Hong Kong, Vietnam and the Philippines and was coupled with evidence from operators that significant fuel savings were made on the existing Hong Kong flight in the trial.

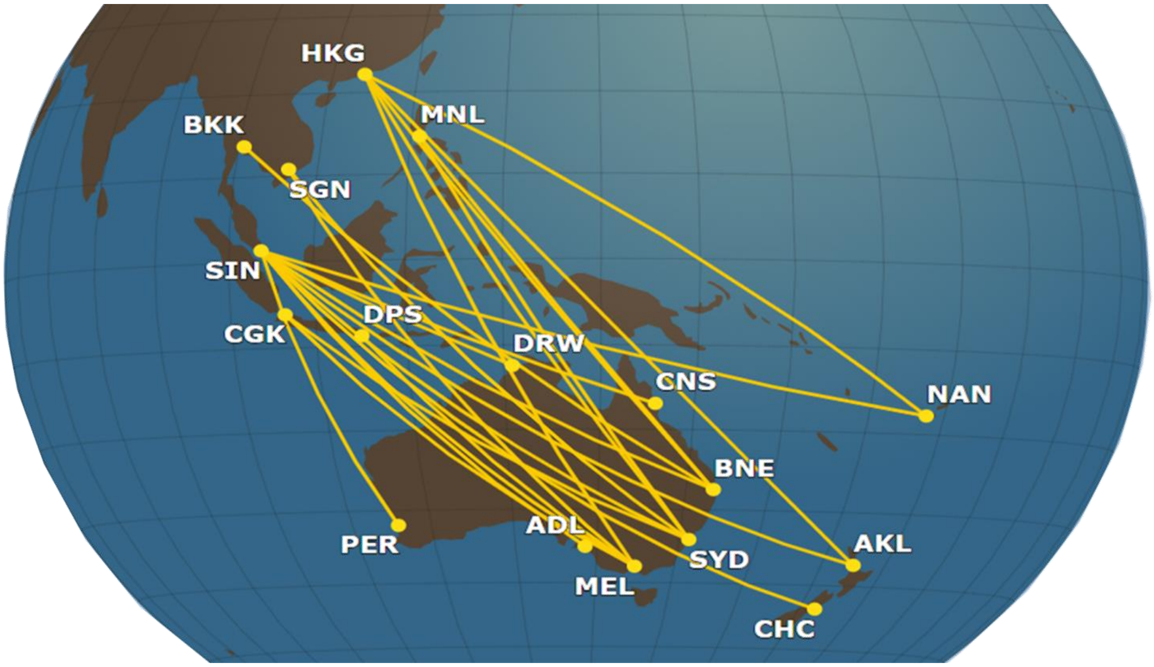
A more in-depth analysis of proposed city pairs was conducted ahead of an expansion. This included a review over a longer period (30 days) of where exactly certain flights were crossing at the boundary to meet the identified opportunity to have trial flights transit particular airspace volumes.

A review of boundary crossing times of proposed trial flights was conducted similar to the first phase to determine a segregation of flights. This formed part of a collaborative effort to determine the shared appetite for a safe expansion.

In the most recent AUSINDO meeting, both ANSPs discussed the considerations to progressing with further expansion recognising the evidence of benefits from the trial to date. The decision was made to operationalise the existing trial with the existing flights and look at gradual expansion opportunities where possible.

The projected saturation of this airspace will require appropriate automation of ATM systems to deliver efficiency gains. However, future expansion is not just limited to ATM system modernisation but factors including airspace classification in line with increased CNS capabilities that may support a safe expansion. Additionally, the approval of reduced separation standards in line with the increased CNS capabilities will derive further efficiency gains and provide more opportunities to expand. On top of all of this though, is the consultation with impacted operational staff and ongoing feedback between operators and service providers through established forums.





Best Practices

- Strong operational relationships with neighbouring service providers and established bilateral meetings between operational staff
- ATC system automated coordination (AIDC)
- Appropriate CNS facilities and equipment to maintain safe coordination
- Minimised usage of voice coordination
- Low Density traffic volumes
- Strong safety cultures including robust reporting cultures to record safety occurrences and mature safety systems
- Starting with a selected set of flights in high-density volumes and strategically segregating flights to ensure all movements with flexible routing options are not arriving at the boundary at the same time
- Discussing with neighbouring service providers on safe limits
- Robust consultation with operational staff and enablement of processes to receive feedback
- Ongoing consultation with operational staff
- Ongoing consultation with neighbouring service providers
- Gradual and measured increased to traffic to allow operational staff to be comfortable

Civil Aviation Authority of Singapore's Implementation of Direct Routing Operations (DRO)

Background

To support the ongoing modernisation of Air Traffic Management (ATM) and in alignment with the ICAO Asia/Pacific Seamless Air Navigation Services Plan, the Civil Aviation Authority of Singapore (CAAS) has undertaken a phased implementation of Direct Route Operations (DRO) within the Singapore Flight Information Region (FIR), including cross-border DRO in collaboration with AirNav Indonesia. This initiative is a key component of Singapore's broader strategy to enhance flight efficiency, reduce environmental impact, and strengthen regional interoperability. In addition to improving operational effectiveness, the implementation of DRO contributes to two strategic objectives: (i) advancing sustainability by enabling shorter, more fuel-efficient flight paths that reduce carbon emissions, and (ii) establishing an initial foundational step toward future development of Free Route Airspace (FRA), supporting the progressive evolution of next-generation ATM initiatives across the region.

The DRO initiative, introduced by CAAS in 2022, enables aircraft operating within designated portions of upper airspace to file direct routes between defined waypoints, instead of following the fixed ATS route network. This facilitates reduced flight times, improved fuel efficiency, and more efficient utilisation of available airspace capacity. DRO is currently available to aircraft operating between flight levels FL290 and FL460 (both inclusive) and may be planned at any time of day. Operators retain the option to file flight plans along established ATS routes when preferred. The ATM automation system provides the functions that assist Air Traffic Control Officers (ATCOs) in distinguishing between standard ATS route operations and direct route operations, thereby supporting effective monitoring and management of both operations.

Implementation of Direct routing Operations (DRO)

Each phase of DRO implementation was preceded by operational trials, which enabled the ATCOs to become familiar with the new procedures and supported the systematic identification and mitigation of operational hazards. Feedback gathered from both ATCOs and aircraft operators during these trials was used to refine subsequent phases. The initial phase of DRO was implemented in September 2022 for arrivals into Changi Airport via ATS routes L642 and N892, followed in October 2022 by the expansion of DRO to north-south overflight routes. Full 24-hour availability was subsequently introduced in early 2023.

To facilitate the progressive implementation, CAAS introduced updated procedures, conducted ongoing operational monitoring, and sought feedback to support the ATCOs in managing evolving traffic patterns as traffic volumes increased during the post-COVID recovery period. Close coordination with neighbouring ANSPs has been essential to maintaining operational efficiency and preventing any reduction in safety margins or airspace capacity. A key achievement was the implementation of cross-border DRO with AirNav Indonesia in September 2024, enabling cross-border direct routing operations. Engagement with other neighbouring ANSPs is ongoing to support broader regional application.

Safety Assessment and Risk Management

The implementation of DRO was undertaken through a phased approach supported by a comprehensive safety assessment framework. Each phase was preceded by systematic safety analyses to identify potential hazards, assess system readiness, and evaluate impacts on controller workload, operating procedures and human factors. These assessments enabled timely introduction of appropriate mitigations, including procedural updates, systems adjustments, and targeted controller briefings prior to operational deployment.

Stakeholder engagement was integral to the safety assurance process. CAAS maintained continuous coordination with aircraft operators, ATCOs, and neighbouring ANSPs throughout both planning and implementation phases. Operators were kept informed through timely publications of Notices to Airmen (NOTAMs) and amendments to Aeronautical Information Publication (AIP), while adjacent ANSPs were consulted to support harmonised procedures and seamless cross-border coordination. This collaborative approach ensured that the operational changes were introduced in a transparent, harmonised, and safely centred manner.

The safety assessment conducted by CAAS concluded that the implementation of DRO presented a low level of safety risk, with minimal or no adverse impact observed across all evaluated aspects. ATCOs were already familiar with issuing direct routing as part of routine tactical operations, for example during weather avoidance or traffic sequencing adjustments. Sector-to-sector coordination arrangements remained unchanged, and radiotelephony phraseology associated with direct routing clearances remained consistent with established practices. The ATM system continued to support trajectory updates and conflict detection, with only minor system refinements required to ensure the appropriate display of Electronic Flight Strips (EFS) for critical Reporting Points (RP). As a result, the transition to DRO was readily accommodated within existing operational environment and did not impact ATCO workload significantly. For cross-border operations, adjacent ANSPs were consulted to ensure harmonisation of procedures and effective coordination. The phased implementation of DRO led to minimal training requirements for the ATCOs.

The primary impact of DRO relate to flight planning, and no technical modifications to onboard aircraft systems or additional pilot training were required. Aircraft operators were notified of applicable DRO routes options through NOTAMs and subsequent AIP amendments prior to the trials and full implementation. Workload for Air Traffic Control Support Officers (ATCSOs) remained stable, as updates to the Aeronautical Information Management (AIM) system allowed for the appropriate handling of flight plans incorporating DRO.

Overall, DRO implementation remained as a low-risk initiative with minimal safety implications. No changes were required to team structures, coordination procedures, phraseology, or communication practices. Staffing levels, duty arrangements, and competency requirements remained unchanged. Human performance factors, including workload, job satisfaction, and role responsibilities, were not adversely affected, in part due to the capability of existing systems, the robustness of established procedures, and incremental implementation phases that facilitated familiarisation and operational buy-in. Potential hazards related to flight strip management and operational situational awareness were identified, assessed, and effectively mitigated through existing or newly proposed controls, and post-implementation reviews have not revealed any additional safety concerns.

Outcomes and Observations

Preliminary outcomes from CAAS' internal implementation of DRO has been highly encouraging. Aircraft operators have reported quantifiable reduction in flight time and fuel burn, resulting in corresponding decrease in carbon emissions and operational costs.

From an ATM perspective, the flexibility offered by DRO has contributed to more efficient traffic distribution, improved tactical and strategic predictability, and enhanced utilisation of available airspace capacity, particularly during periods of high demand. The conduct of the trials has also underscored the critical role of regional collaboration. Seamless cross-border operations rely on harmonised procedures, timely and accurate information exchange, and effective communication between ANSPs. The collaborative environment fostered through these initiatives has strengthened trust and interoperability across the region and laid a strong foundation for future developments.

Future Plans

Looking ahead, CAAS intends to progressively extend the application DRO to additional ATS routes within the Singapore FIR, prioritising areas where enhancements to surveillance and communication capabilities are already established or forthcoming. As DRO is expanded, the structured, phased, and consultative approach adopted to date will continue to guide implementation, ensuring safety considerations remain paramount while enabling further improvements in operational efficiency and airspace flexibility.

CAAS remains committed to its long-term objective of transitioning towards a full Free Route Airspace (FRA) environment, consistent with the ICAO's Global Air Navigation Plan and aligned with ongoing regional FRA initiatives. This will include close cooperation with regional partners to harmonise operational procedures and to support the development of a common roadmap for the phased and enduring implementation of FRA across the Asia and Pacific region.

Through these sustained efforts, Singapore aims to advance the efficiency, flexibility, and environmental sustainability of its air traffic management system, while maintaining the highest standards of safety and reinforcing regional interoperability and collaboration.

AirNav Indonesia

Background

The implementation of User Preferred Routes (UPR) and early elements of Free Route Trajectory Operations (FRTO) in Indonesia provides an important example of how an ANSP can progressively introduce flexible routing concepts under challenging operational conditions. During the COVID-19 period, Indonesia experienced a significant reduction in air traffic across both the Jakarta FIR and the Ujung Pandang FIR. This environment created an opportunity for AirNav Indonesia to explore more flexible, user-driven routing options that could support airline operational efficiency while maintaining safety and service continuity.

In June 8th, 2020, AirNav Indonesia initiated the development of a UPR operational concept in response to formal requests from airspace users, coordinated through the International Air Transport Association (IATA) and DGCA. Airlines sought more efficient routing to minimise fuel burn, flight time, and operating costs during a period of reduced passenger demand and increasing reliance on cargo and essential operations. Drawing upon international best practices and the global evolution of free-route concepts, AirNav Indonesia developed a structured approach to enable UPR operations within Indonesian upper airspace during low-traffic conditions.

The UPR concept adopted by Indonesia aligned closely with the foundational principles of FRTO as outlined in the ICAO Global Air Navigation Plan (GANP) and the APAC Seamless ANS Plan. In particular, it introduced a level of flight planning flexibility beyond the fixed ATS route structure by allowing aircraft to plan point-to-point trajectories optimised for winds, aircraft performance, and day-of-operation conditions. This operational design supported airline efficiency goals while providing AirNav Indonesia with valuable operational experience in managing dynamic, non-structured flows—an essential preparatory step toward eventual FRA implementation.

Operational trials conducted by AirNav Indonesia demonstrated measurable benefits consistent with studies from other regions, including reductions in track miles, flight time, fuel consumption, and CO_2 emissions. These outcomes validated the suitability of flexible routing in Indonesia's high-level airspace and provided key insights into safety management, coordination procedures, controller workload, and system readiness.

The Indonesian UPR experience therefore represents an important regional case study on how an ANSP can adopt a phased, risk-managed approach to trajectory-based operations, starting with UPR under limited traffic conditions, refining procedures through operational trials, and progressively preparing for broader FRTO implementation. The lessons learned from Indonesia's approach contribute directly to the regional body of best practices and support other APAC States seeking to operationalise UPR and transition toward Free Route Airspace (FRA) and cross-border FRTO in the future.

Objectives

The primary objective of Indonesia's UPR and FRTO implementation program is to progressively enable more flexible, efficient, and user-preferred trajectories within the Jakarta (WIIF) and Makassar (WAAF) FIRs in alignment with the ICAO Global Air

Navigation Plan (GANP) and the Asia/Pacific Seamless ANS Plan. The initiative supports the transition from fixed ATS route structures toward a trajectory-based environment through phased deployment, operational trials, and regional harmonization.

Specific objectives of the program include:

1. **Enhancing Operational Efficiency**

To allow airspace users to operate more direct, wind-optimized, and fuel-efficient trajectories, resulting in measurable reductions in flight time, fuel burn, and operational cost.

2. **Supporting Environmental Sustainability**

To contribute to national and regional goals for CO_2 reduction by enabling flexible routes that minimize fuel consumption, consistent with Indonesia's transport-sector climate mitigation commitments.

3. **Improving Airspace Utilization and Capacity**

To increase the effective use of upper airspace by reducing reliance on fixed ATS routes, managing congestion points more effectively, and enabling dynamic allocation of airspace in line with FUA and advanced ASM principles.

4. **Strengthening Inter-FIR and Regional Interoperability**

To harmonize procedures, coordination mechanisms, and trajectory management with adjacent FIRs, particularly in support of cross-boundary UPR and the Southeast Asia–Oceania FRTO corridor.

5. **Ensuring Safety Through Structured and Phased Implementation**

To maintain and enhance safety performance by applying structured safety assessments, conflict detection tools, human-factors considerations, and continuous monitoring during each phase of implementation.

6. **Enhancing Predictability and Network Performance**

To improve overall ATM network predictability by reducing trajectory uncertainty, supporting ATFM integration, and enabling more consistent delivery of preferred trajectories across borders.

7. **Building Operational Readiness Toward FRA**

To develop the technical, procedural, regulatory, and human-performance foundations required for the transition from UPR to Free Route Airspace (FRA) and, ultimately, the wider FRTO concept under the ASBU framework.

Implementation Phases of UPR in Indonesia (2020–2025)

AirNav Indonesia adopted a phased, risk-managed, and data-driven approach in the implementation of User Preferred Routes (UPR) as a transitional step towards Free Route

Trajectory Operations (FRTO). Recognising that ATCOs are highly familiar with existing traffic flows, congestion points, and established operational patterns within both the Jakarta and Ujung Pandang FIRs, the introduction of UPR was intentionally initiated at a very limited scale. This approach ensured that safety, workload stability, and system readiness were maintained throughout each stage of expansion.

The implementation progressed incrementally, beginning with a single city-pair operated by Qatar Airways, and was expanded in stages based on performance outcomes, safety assessments, and stakeholder feedback. The overall development of UPR in Indonesia from 2020 to 2025 is summarised below.

2020 – Initial Trial Phase

- UPR operations commenced on 8 June 2020, limited to international overflying flights within Jakarta FIR & Ujung Pandang FIR.
- Trial operations were constrained to FL350–FL600 and utilised published waypoints only. Also, Intermediate points include NAVAID and ATS route (at least for 60 minutes, the flight must use intermediate points)
- Qatar Airways conducted the first UPR flight.
- Proposal submission procedures are not earlier than 12 hours and not later than 6 hours before EOBT. AirNav will respond to this proposal within 3 hours after submission.
- The objective of this phase was to validate safety and controller workload under low-traffic conditions.

2021 – Second Trial Phase: Introduction of Latitude/Longitude Waypoints

- Beginning May 2021, limited to international overflying flights within Jakarta FIR & Ujung Pandang FIR
- Trial operations were constrained to FL350–FL600 and utilised published waypoints and Intermediate points, including NAVAID and ATS route. Indonesia also introduced latitude/longitude designated points as entry/exit to improve routing flexibility.
- At least for 60 minutes, the flight must use intermediate points for ATC monitoring purposes
- Adjustments were made to UPR proposal submission timelines to allow more effective pre-tactical evaluation and ATC coordination with at least 3 hours before EOBT and responded to AirNav within 2 hours after submission.
- UPR operations at this stage remained limited to overflying flights.

2022 – Third Trial Phase: Expansion to International Arrival and Departure Flights

- From April 2022, UPR eligibility was expanded to include international arrival and departure flights, in addition to overflying traffic.
- The eligible altitude band was widened between FL310-FL600
- Utilised published waypoints along the entry, Intermediate, and exit points, including NAVAID and latitude/longitude designated points as entry/exit to improve routing flexibility.
- At least for 60 minutes, the flight must use intermediate points for ATC monitoring purposes
- Adjustments were made to UPR proposal submission timelines to allow more effective pre-tactical evaluation and ATC coordination with at least 3 hours before EOBT, and responded to AirNav within 2 hours after submission.
- EVA Air and Hong Kong Express began regular participation.
- The first comprehensive performance dataset was collected to support safety and efficiency analysis.
- 11 November 2022 – first formal evaluation completed.

2023 – Fourth Phase: Confidence Phase

- From December 2022 to October 2023, Indonesia has confidence to publish the UPR trial incorporated in AIP
- The eligible altitude band between FL310 and FL600
- Utilised published waypoints along the entry, Intermediate, and exit points, including NAVAID and latitude/longitude designated points as entry/exit to improve routing flexibility. At least for 60 minutes, the flight must use intermediate points for ATC monitoring purposes
- Adjustments were made to UPR proposal submission timelines to allow more effective pre-tactical evaluation and ATC coordination with at least 3 hours before EOBT, and responded to AirNav as soon as possible after submission.

2023 – Operational Consolidation and Major Evaluations

- A total of 349 Hajj flights were successfully operated using UPR within the Indonesian FIRs, providing important operational data and supporting the final readiness assessment.
- 8–9 June 2023 – second formal evaluation completed.

- Evaluation results recommended an adjustment to the UPR altitude eligibility, refining the operational level band from FL310–FL600 to FL330–FL600 to ensure more appropriate level utilisation and maintain controller workload predictability.

2023 – Publication

- Since 5th October 2023, Indonesia has fully implemented the UPR
- UPR is available within Jakarta FIR and Ujung Pandang FIR from FL 330 to FL 600, with exemption areas within Jakarta FIR where the provision of ATS is delegated to Singapore (See details in ENR 2.1).
- UPR is applied for international flights within Jakarta FIR and Ujung Pandang FIR. An international flight is a flight that has an international flight approval and includes flights departing from Indonesia to other countries, but for technical or refuelling reasons makes a stopover or transit at an airport in Indonesia.
- Aircraft equipment and capabilities must include:
  a. RVSM;
  b. RNP10 / RNAV10;
  c. GNSS;
  d. ADS-B; and

The minimum criteria listed above must be notified in the flight plan.

- Flight Planning Requirements for UPR
  a. UPR flight plan route structure shall be constructed as follows:
  1. UPR flights entering Jakarta FIR and Ujung Pandang FIR may plan via published waypoints, or a position designated as latitude and longitude at the FIR common boundary;
  2. UPR flights exiting Jakarta FIR and Ujung Pandang FIR may be planned via published waypoints;
  3. UPR flights may plan via intermediary point within Jakarta FIR and Ujung Pandang FIR via published waypoints, navigation aids, and/or positions designated as latitude and longitude;
  4. UPR flights may be planned to include published ATS routes;
  5. UPR flights that operates within Jakarta FIR and Ujung Pandang FIR for more than 60 minutes, shall plan via intermediary waypoint(s) with a time interval not exceeding 60 minutes;

6. UPR flights shall avoid prohibited areas, restricted areas, danger areas, and reserved/blocked airspace within Jakarta FIR and Ujung Pandang FIR;
7. Waypoints shall use waypoints as published in AIP Indonesia part ENR 4.4.

b. A position designated in latitude and longitude shall be expressed in a format of degrees and minutes (11 characters), for example 0102S10435E;

c. Aircraft operator shall fill the word “UPRINA” as part of “RMK/” in item 18 of the flight plan

2023 to 2024 – Expansion to Additional Adjacent FIRs

- Since end of 2023, cross-border Direct Routing Operations (DRO) and UPR have been progressively implemented through established LOCA arrangements with several adjacent FIRs, including:
  a. Oakland Oceanic FIR (FAA) – UPR cross-boundary operations
  b. Port Moresby FIR (Papua New Guinea) – UPR cross-boundary operations
  c. Singapore FIR – implemented through DRO cross-border routing
  d. Brisbane and Melbourne FIRs (Australia) – trial cross-boundary UPR operations
- 23 October 2023 – Indonesia signed the Letter of Intent (LoI) on Southeast Asia–Oceania FRTO Implementation, formalising its commitment to regional FRA and cross-border FRTO development.
- In 2024, total UPR movements reached approximately 4200 flights across both Jakarta and Makassar FIRs.

2025 – Further UPR Enhancement

- Updated the Letter of Understanding (LoU) for the Australia–Indonesia Cross-FIR Boundary UPR Trial, incorporating additional participating airlines and expanding cross-border UPR movements to up to 70 city-pair flights.
- Jetstar contributed to further growth through the addition of 15 new city-pair UPR flights in recent months, demonstrating increasing airline confidence and operational demand for cross-boundary flexible routing.
- Initiated a review of potential simplification of UPR flight-planning requirements, including the assessment of more flexible provisions within the AIP to improve usability, reduce administrative burden, and support future FRTO transition.

Systems, Tools, and Regulatory Framework

To enable safe, predictable, and scalable UPR operations within the Jakarta and Makassar FIRs, AirNav Indonesia strengthened its regulatory foundations, enhanced ATM system capabilities, and introduced the operational tools required to support flexible trajectory management. These enablers were developed to ensure compliance with ICAO provisions, facilitate interoperability with adjacent FIRs, and prepare the national airspace structure for the long-term transition from DCT and UPR toward cross-border FRA and future FRTO implementation. The core regulatory, technical, and operational elements supporting UPR implementation are summarised below:

- Alignment with ICAO Annex 11, PANS-ATM (Doc 4444), and relevant ASBU modules supporting DCT/UPR/FRA operations.
- Legal and regulatory review of DCT/UPR/FRA permissibility, including applicability for High Seas operations.
- Review and updating of Letters of Agreement (LoA/LOCA) with adjacent FIRs to support UPR/DRO cross-boundary operations.
- Definition of eligible airspace volumes, sector configuration, and flight level limits for UPR operations.
- Development pathway from DCT → UPR → Cross-Border FRA, aligned with regional FRTO planning.
- Establishment of entry, exit, and intermediate (latitude/longitude) points to support flexible user-preferred trajectories.
- Integration of AFUA (Airspace Flexible Use) concepts and dynamic sectorisation to accommodate variable demand patterns.
- Planning and enabling interoperability with adjacent FIRs for cross-border UPR operations.
- Deployment of controller support tools including MTCD, CPAR, and adherence monitoring for conflict detection and trajectory conformance.
- Upgrading Flight Data Processing (FDP) capabilities to accommodate non-structured and flexible UPR trajectories.
- Strengthening AIDC inter-FIR automation and enhancing ATFM integration for improved predictability and coordination.
- Digital AIS/AIM publication of UPR procedures through the AIRAC cycle, ensuring timely and standardised information for operators.
- Use of Multi-Sector Planner (MSP) functions to support strategic management of UPR traffic across multiple sectors.

Performance Outcomes

The growth in UPR utilisation has shown a steady and sustained upward trend from its initial implementation in 2020 through 2025. This increase reflects several key drivers, including the rising number of participating airlines, improved operator confidence in UPR planning, and the growing familiarity of controllers in both Jakarta and Makassar ACCs with the management of non-structured trajectories. The progressive introduction of cross-border UPR and DRO arrangements—particularly with Oakland Oceanic, Port Moresby, Singapore, Brisbane, and Melbourne FIRs—further contributed to higher utilisation, as a broader range of long-haul city-pairs became eligible for flexible routing. These combined operational, procedural, and regional enablers resulted in a consistent upward trajectory in UPR movements, as illustrated in the chart below

Figure 1: Indonesia UPR Flight Movement chart 2023 - 2025

Following the growth in UPR uptake, several key performance outcomes were observed across operational efficiency, environmental performance, predictability, and safety. These outcomes highlight the effectiveness of UPR in delivering measurable benefits while maintaining safe and stable operations in both FIRs.

Operational Efficiency

Sample-based analysis of UPR operations within Indonesian airspace demonstrates clear and consistent reductions in both track distance and flying time when compared with conventional ATS routing. Across representative city-pair examples, the reduction in track mileage ranged from 106 NM to 232 NM, resulting in an average saving of approximately 190 NM per flight. Correspondingly, block-time reductions ranged from 14 to 34 minutes, with an average saving of around 25 minutes per flight. These results underscore the operational advantages of UPR, particularly for medium- and long-haul flows, where optimised routing enables airlines to benefit from more direct trajectories and favourable wind conditions.

Environmental Gains

To quantify the environmental benefits of UPR operations, AirNav Indonesia applied a standardised CO_2 estimation method based on the relationship between distance savings, fuel burn, and associated emissions. Using the average distance reduction derived from the sample flights (approximately 190 NM per flight), a representative long-haul fuel-consumption factor of 10 kg per NM, and the ICAO jet-fuel emission coefficient of 3.16 kg CO_2 per kg of fuel, each UPR flight is estimated to save approximately 1.9 tonnes of fuel and reduce emissions by roughly 6 tonnes of CO_2 compared to the corresponding ATS route.

For this case study, the cumulative CO_2 reduction was calculated for the period October 2023 to October 2025, reflecting the phase following full operational implementation in both FIRs, during which UPR utilisation increased sharply due to expanded airline participation and cross-boundary applicability. Applying the per-flight CO_2 reduction value to the total number of UPR flights recorded during this period indicates that UPR implementation has produced a substantial aggregate environmental benefit, with total avoided emissions reaching tens of thousands of tonnes of CO_2. This demonstrates the value of UPR as a practical and scalable operational measure that supports national and regional sustainability objectives while enabling a gradual transition toward FRTO.

Predictability

UPR operations also contributed to improved predictability in en-route and arrival phases, particularly for medium- and long-haul flights operating through the Jakarta and Makassar FIRs. The use of optimised and wind-favourable trajectories reduced variations in actual versus planned flight times, resulting in more stable Estimated Times of Arrival (ETA) and improved alignment between flight-plan data and actual operations. This increased predictability supported more efficient ATFM demand management and reduced the need for tactical interventions by controllers. During periods of elevated seasonal demand—such as the operation of Hajj flights in 2023—UPR routes demonstrated consistent conformance and did not introduce additional flow-management constraints, reinforcing the suitability of UPR for predictable and high-volume operations.

Safety & Human Factors

Post-implementation safety monitoring confirmed that the introduction of UPR did not increase en-route controller workload or sector complexity within either Indonesian FIR. The phased implementation strategy, combined with progressive controller familiarisation and supporting automation tools such as CPAR and conformance monitoring, enabled UPR flights to be integrated safely alongside conventional traffic. No increase in conflict rates or separation-related occurrences attributable to UPR operations was observed. Enhancements to FDP processing, improved data accuracy for latitude/longitude points, and strengthened AIDC coordination with adjacent FIRs further supported safe trajectory management. Feedback from Jakarta and Makassar ACCs indicated that controller confidence in handling UPR traffic improved significantly over time, confirming that UPR can be accommodated safely in routine operations when supported by appropriate procedures, system capabilities, and monitoring mechanisms.

Challenges

Despite the positive performance outcomes achieved through UPR implementation, several operational and system-related challenges were identified through routine monitoring and evaluation activities in Jakarta ACC and Makassar ACC. These challenges highlight areas requiring further refinement in procedures, system configuration, and stakeholder understanding to support more consistent and reliable UPR operations.

High Rate of FPL Rejection in ATC Systems

Evaluation of UPR flight plan processing for the period January–May 2025 shows that 40–52% of submitted UPR flight plans were rejected by the ATC system. This indicates that a significant proportion of operator-filed UPR routes did not meet system validation criteria, resulting in inconsistent approval rates and additional workload for CFPL and ATC units. Frequent causes include formatting errors, incompatibility with system rules, or incorrect waypoint structures. This challenge underscores the need for improved guidance to operators, system logic refinement, and enhanced validation tools.

Incorrect or Missing UPR-Related FPL Information

Common issues identified during operations include missing UPRINA remarks in Field 18, incorrect formatting, and the inclusion of UPR remarks for flights that do not operate within Indonesian FIRs. Domestic flights and Functional Check Flights (FCF) were also found to incorrectly include UPR indicators, demonstrating inconsistent understanding of eligibility requirements among operators and flight planning systems.

Use of Non-Compliant or Prohibited Routing Elements

Several UPR flight plans were filed using waypoints not published in AIP Indonesia (ENR 4.4) or using points designated for SID/STAR/VFR operations. Additional cases included UPR trajectories inadvertently entering prohibited, restricted, or danger (P/R/D) areas, which triggered system rejection or required manual correction by ATC staff. These issues highlight the importance of strict waypoint governance and clearer operator guidance.

Operational and Regulatory Constraints Related to UPR Notification Requirements

A further challenge arises from industry feedback regarding the practicality of AIP-mandated UPR notification procedures. Under current requirements, operators must submit a separate email notification to the Indonesia Flight Plan Center (FPLC) for each UPR flight, or provide a bulk notification valid for a maximum period of three months. Airlines—particularly those operating high-frequency long-haul, ad-hoc, and freighter flights—have expressed difficulty in meeting this requirement, as their dispatch systems generate numerous UPR-eligible flight plans automatically, and operational schedules often change more frequently than the three-month notification window allows. While AirNav Indonesia acknowledges these concerns, the notification procedure remains necessary to support accurate UPR monitoring, verification, and statistical reporting. Balancing operational practicality for airlines with AirNav’s need for reliable UPR utilisation data remains an ongoing regulatory consideration under active review.

Conclusion

Implementing free route operations can deliver significant efficiency and environmental benefits. By following a structured, phased approach States/Administrations and ANSPs can implement free-route operations and realise the benefits of operating an optimal trajectory within their own airspace, and ultimately on a cross-border and regionwide basis.

FRTO aligns with ICAO's Global Air Navigation Plan (GANP) and the APAC Seamless ANS Plan and will be necessary to ensure the region can safely and efficiently manage the forecast regional growth.

Successful FRTO implementation depends on careful planning, collaboration, and continuous safety assurance. The staged approach outlined in this guidance—supported by comprehensive risk assessments, stakeholder engagement, and performance monitoring—ensures that operational efficiency gains are achieved without compromising safety. Early involvement of regulators, airlines, controllers, and military partners remains critical to achieving balanced outcomes and fostering mutual trust across all stakeholders.

Key Lessons from Operational Trials Conducted in APAC:

- **Start small:** low-traffic corridors, limited city-pairs, or specific altitude segments.
- **Phased approach:** modelling/paper trials → operational trials → full implementation.
- **Airline and Controller buy-in:** involve ATCOs and airlines early through simulation and feedback loops.
- **Measure outcomes:** fuel/CO_2 savings, participation rates, workload, congestion points.
- **Use results to expand:** positive data supports larger implementation zones and stakeholder buy in.

Ultimately, FRTO is not only a technical evolution, but a cultural and operational transformation towards broader trajectory-based operations (TBO) and seamless regional air traffic management. Through application of the principles, methodologies, and lessons learned contained in this guidance material, APAC States/Administrations can collectively move toward a harmonized, interoperable airspace system that delivers measurable safety, environmental, and economic benefits for the entire aviation community.