



APAC TBO
PATHFINDER

Trajectory-Based Operations in the Asia Pacific region

1st Edition (V1.1 September 2025)

EXECUTIVE SUMMARY

Pathway to TBO in Asia Pacific

The Asia Pacific (APAC) region presents a complex environment with significant numbers of Airspace Users (AUs) and Air Navigation Service Providers (ANSPs). It also faces growing air traffic demand and increasingly complex airspace with new airspace users. Trajectory-Based Operations (TBO) addresses these challenges by enhancing efficiency, predictability, and collaboration in Air Traffic Management (ATM).

TBO is a realisation of the ICAO Global ATM Operational Concept, providing a trajectory-centric approach to flight planning and execution. It enables better synchronisation of airspace operations, optimises flight efficiency, and aligns with global ATM modernisation efforts.

The APAC TBO Pathfinder Project aims to harmonise and accelerate the region's implementation of the ICAO global TBO concept in order to meet the anticipated growth in civil air traffic.

The Project promotes regional collaboration between ANSPs and AUs, in collaboration with Civil Air Navigation Services Organisation (CANSO) and International Air Transport Association (IATA), to identify operational priorities and develop a TBO roadmap to that aligns the implementation planning to improve ATM efficiency within the APAC region.

Strategic alignment, regional collaboration, and continued innovation are key success factors for development and implementation of TBO.

THE NEED FOR TBO

Challenges in Today's ATM



Lack of real-time updates into strategic flight plans reduces predictability in flight operations, leading to inefficiencies in fuel optimisation and flight scheduling.

Limited information exchange between AUs and ANSPs leading to inconsistencies in trajectory predictions. Without knowledge on constraints, ATM stakeholders rely on incomplete data in planning, leading to operational inefficiencies.



Airspace congestion leading to inefficiencies and delays

Decision-making based on local trajectories rather than one that is shared and collaboratively managed, making it harder to operate flights seamlessly across borders



THE NEED FOR TBO

Why TBO?

TBO enhances flight operations by enabling precise trajectory management, reducing fuel consumption, minimising delays, and improving airspace utilisation. By integrating advanced planning and real-time decision-making, TBO supports **efficient, predictable, and sustainable aviation operations**.

Optimised Airspace Utilisation

- ▶ Increased throughput with precise trajectories
- ▶ Enhanced collaborative decision-making for efficiency

Improved Flight Efficiency

- ▶ More effective route management enhancing airline scheduling
- ▶ Optimised aircraft trajectories for reduced fuel consumption

Flexibility for Airspace Users

- ▶ Increased adaptability through early trajectory adjustments
- ▶ Collaborative trajectory negotiations for optimised flight operations

Supporting Aviation Sustainability

- ▶ Optimised flight profiles reducing holding times and fuel burn



More Efficient ATC Operations

- ▶ Reduced tactical intervention, enabling better resource utilisation
- ▶ Streamlined airspace management with advanced planning capability

Increased Predictability & Reliability

- ▶ Enhanced reliability through timely trajectory updates
- ▶ Minimised delays with improved operational coordination

Enhanced Regional Interoperability

- ▶ Real-time data sharing for smoother traffic flow management

WHAT IS TBO?

“A Shift from Traditional ATM to a Trajectory-Based Approach”

Current ATM environment is segmented and tactical. Flight trajectories are managed reactively, often leading to inefficiencies and unpredictable operational adjustments. TBO transforms ATM by shifting towards a trajectory-centric approach, ensuring every flight is strategically planned and optimised from departure to arrival.

Understanding TBO

At its core, TBO manages a flight trajectory as a shared plan, integrating real-time data to make precise adjustments. It enables:

- **Sharing** of trajectory information with all relevant stakeholders for a common view
- **Managing** trajectory information through Collaborative Decision Making
- **Using** the trajectory as a unified operational plan during flight execution

Evolution of ATM: From Traditional ATM to TBO

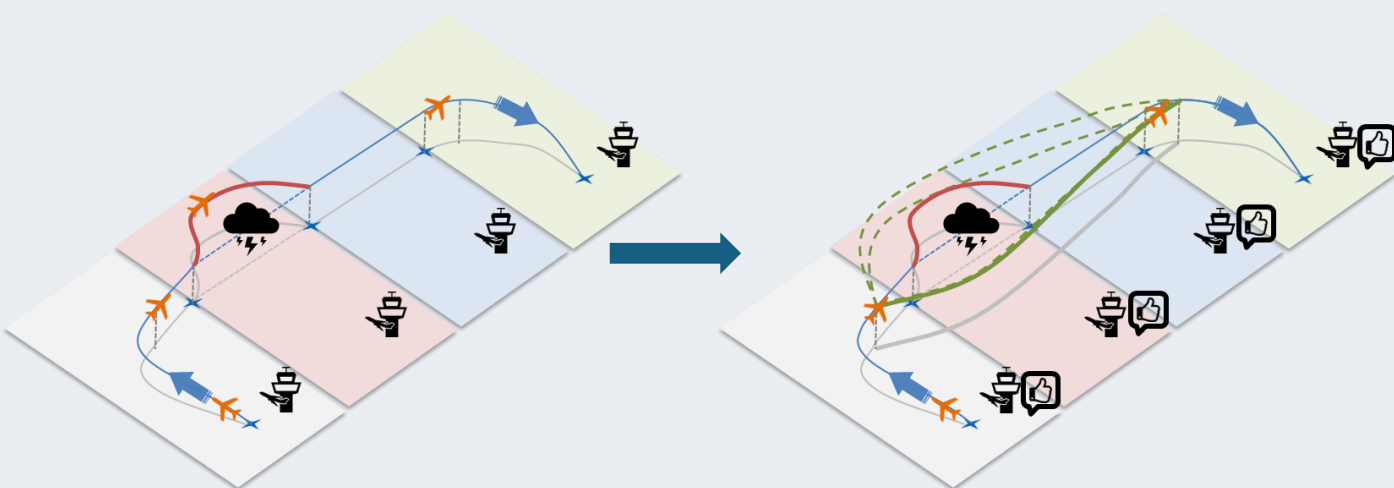
Traditional ATM		TBO Approach
Segmented control by ATC		Continuous trajectory management, minimising impact of disruptions
Tactical, reactive adjustments		Strategic, pre-planned trajectory optimisation
Limited data-sharing		Transparent information exchange via SWIM and FF-ICE
Voiced-based clearance		Digital trajectory negotiations and clearances with ADS-C and CPDLC
Restricted collaboration between stakeholders		Collaborative decision-making between ANSPs, AUs, airports, MET services and other ATM stakeholders

WHAT IS TBO?

Visualising TBO

Legend:

-  Air Traffic Control
-  Original Trajectory
-  Non-TBO Trajectory
- TBO:**
-  Negotiating Trajectories
-  Agreed Trajectory



Today in a non-TBO environment

Full TBO environment

In traditional air traffic management, aircraft encountering adverse weather would rely on immediate rerouting from their current ATC unit. While this addresses the immediate weather concern, it often results in **suboptimal flight trajectories** when considering the entire journey.

A TBO environment transforms this approach through **enhanced stakeholder collaboration** and **information sharing**. Aircraft receives advance notice of potential weather disruptions to their planned trajectory, enabling them to **proactively coordinate** with all ATC units along their route. This collaborative process allows the aircraft to **negotiate alternative trajectories** that account for weather avoidance while considering the operational constraints of each ATC unit. Through this negotiation, several potential trajectories are evaluated until a mutually acceptable solution emerges. The final agreed trajectory is then communicated to all stakeholders, resulting in a more **efficient overall flight operations**.

WHAT IS TBO?

TBO Building Blocks

TBO is enabled by:

SWIM

System Wide Information Management (SWIM)

Provides a information-sharing infrastructure that facilitates the exchange of information among all stakeholders, including ANSPs, AUs, aerodrome operators, and meteorological services provider.

FF-ICE

Flight and Flow Information for a Collaborative Environment (FF-ICE)

Enables stakeholders to collaboratively plan and optimise flight trajectories throughout the trajectory lifetime by considering various factors such as airspace capacity, weather conditions, and airspace users' preferences. FF-ICE also enables post-departure trajectory negotiation and re-planning to respond to changing conditions, and ensures all stakeholders are informed of the updated trajectory.

CA

Connected Aircraft (CA)

Enables information exchange between flight deck and relevant aviation system participants including AUs (e.g. flight crew and OCC), ANSPs, aerodrome operators and other third-party information suppliers (e.g. meteorological services) through the use of performance-based links.

STAKEHOLDER INVOLVEMENT & REGIONAL COLLABORATION

Stakeholders and Their Roles

Aviation Authorities

Modernise regulatory framework to facilitate adoption of advanced technologies and processes

Aerodrome Operators

Leverage TBO for optimised ground operations



ANSPs

Manage trajectories to ensure safe and efficient traffic flows

Airspace Users

Leverage TBO for optimised flight efficiency.

Regional and Global Organisations

Provide global TBO guidance and align regional implementations

Importance of Cross Border Harmonisation

Given APAC’s diverse operational landscape, regional collaboration is essential for a harmonised TBO implementation, ensuring interoperability and consistency of trajectories within and across the region.

CHALLENGES & OPPORTUNITIES FOR ASIA PACIFIC

Challenges

Several ATM initiatives have successfully demonstrated the positive impacts of TBO and its building blocks on airspace efficiency. APAC can leverage insights from these initiatives to shape its implementation strategy.

A major challenge in APAC is the lack of a coordinated mandate for TBO implementation. While full regional harmonisation may be challenging due to varying levels of ATM infrastructure maturity and national priorities, collaborative efforts can help drive ANSPs' and AUs' alignment, ensuring progressive adoption of TBO and its building blocks.

● Sharing of Best Practices & Lessons Learnt

- Lowering implementation risk
- Minimising duplicate efforts

Validation Through Collaboration ●

- Conduct collaborative trials and demonstrations
- Identify harmonisation requirements
- Build confidence in new processes
- Sharing resources and capabilities

Benefits of Regional Coordinated Approach for TBO Implementation

● Ensuring System Interoperability

- Jointly identify and develop key building blocks
- Leverage collective technical expertise
- Establish common standards across borders

Synchronise Regional Progress ●

- Create regional timelines
- Develop roadmaps to align implementation

APAC TBO PATHFINDER PROJECT

About

The APAC TBO Pathfinder Project is an initiative to define, develop and demonstrate the ConOps and requirements for TBO in the APAC region.

Through collaborative efforts to identify operational values and prioritisation of operational scenarios at the regional level, the Project provides clarity on the expected operational processes and benefits, and will develop a roadmap as a pathway to operationalise TBO in the APAC region.

In collaboration with CANSO and IATA, it allows ANSPs and AUs to harmonise their planning and modernisation efforts and improve flight and overall ATM efficiency across the region.

Key Milestones

Define

Define ConOps for TBO in APAC

Demonstrate

Demonstrate TBO processes and validate operational workflows and scenarios by utilising the key TBO building blocks



Develop

Develop TBO roadmap for APAC

Expected Benefits for Pathfinder Members

- Improved and common understanding of TBO and its benefits
- Greater familiarity with operational processes and readiness to implement TBO and its building blocks
- Contribute to the APAC TBO roadmap for harmonised TBO implementation within APAC

NEXT STEPS

Why Leadership is Critical?

Successful adoption of TBO in APAC requires:

- Strategic alignment on plans across key ATM stakeholders such as ANSPs, AUs and regulators
- Collaboration and engagements within and across the region
- Investment in key building blocks of TBO including SWIM, FF-ICE and Connected Aircraft

Communications with ATM stakeholders including leadership buy-in at an early stage is pivotal.

Next Steps

1

Support the APAC TBO Pathfinder Project

- Champion Pathfinder project within your organisation
- Allocate resources for active participation in Pathfinder activities

2

Lead Strategic Implementation

- Support harmonisation of operational processes
- Align capability development roadmap within your organisation with regional TBO objectives
- Prioritise investments in interoperable technologies and systems

TBO is not just an innovation. It is a necessary transformation for APAC's ATM modernisation. Strong commitment from all ATM stakeholders to champion TBO implementation can drive APAC's shift towards modernised airspace efficiency, enhanced ATM predictability, and strengthened regional collaboration.

**“Together, APAC
is charting our
way forward”**



