



WORKING PAPER

FOURTEENTH AIR NAVIGATION CONFERENCE

Montréal, Canada, 26 August to 6 September 2024

Agenda Item 3: Air navigation system performance improvement

3.1: Proposals to improve the efficiency of air navigation services contributing to LTAG

TOWARDS HARMONIZED REALIZATION OF THE ICAO GLOBAL TRAJECTORY-BASED OPERATIONS (TBO) CONCEPT IN THE ASIA-PACIFIC REGION

(Presented by China, Indonesia, Japan, New Zealand,
Republic of Korea, Singapore, Thailand, United States and
Civil Air Navigation Services Organisation (CANSO))

EXECUTIVE SUMMARY

ICAO, through the *Global Air Navigation Plan* (GANP, Doc 9750), envisions the need for a full harmonized global air navigation system built on agreed performance-based standards, with interoperable and scalable systems - this is the essence of trajectory-based operations (TBO).

Through enhanced data sharing and strategic air traffic management (ATM), TBO will improve the predictability of aircraft movement, flight efficiency, and increase utilization of available capacity and operator flexibility. These benefits will contribute to the ICAO long-term aspirational goal (LTAG) for international aviation to achieve net-zero carbon emissions by 2050.

In Asia and Pacific (APAC), the APAC TBO Pathfinder Project was initiated to determine pathways to realize the TBO concept. The project will build on ongoing efforts to accelerate implementation of the mature building blocks of TBO such as system-wide information management (SWIM) and flight and flow – information for a collaborative environment release 1 (FF-ICE/R1) in APAC, and to advance the development of future releases of FF-ICE and the connected aircraft concept by adopting a discovery approach through tabletop exercises, laboratory demonstrations and trials.

Action: The Conference is invited to:

- a) urge regions and States to commit resources to expedite the implementation of TBO building blocks that are considered mature to prevent a prolonged period of mixed-mode environment. This will reduce inefficiencies in the ATM system and delays in the realization of benefits from TBO for all ATM stakeholders; and
- b) support ICAO in expediting its work programme on TBO and its enablers, including the development of a plan and timeline to operationalize TBO service provision as an input to Asia/Pacific Seamless Air Navigation Services (ANS) Plan.

1. INTRODUCTION

1.1 The 13th Air Navigation Conference (AN-Conf/13), emphasized the need for a harmonized transition to globally interoperable trajectory-based operations (TBO) across all domains of air traffic management (ATM) that take into consideration existing and new types of airspace users, through all phases of their flight in line with the *Global Air Traffic Management Operational Concept* (GATMOC), ICAO Doc 9854. ICAO's effort to develop guidance material for the transition to a globally interoperable TBO environment is included in the work programme of the ATM Requirements and Performance Panel (ATMRPP). To contribute to the timely achievement of the long-term aspirational goal (LTAG) of net-zero carbon emissions by 2050 for international aviation, it is important to expedite development of TBO that is proactively and successfully orchestrated at the global level.

1.2 To meet a globally interoperable TBO, ATMRPP suggested proposals for amendment to the initial implementation of FF-ICE services (FF-ICE/R1) to the following ICAO documents: Annexes 2 — *Rules of the Air* and 10 — *Aeronautical Telecommunications, Volume II — Communication Procedures including those with PANS status, Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444), *Procedures for Air Navigation Services — Aeronautical Information Management* (PANS-AIM, Doc 10066); as well as the consequential amendments to Annexes 1 — *Personnel Licensing*, 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes*, Part II — *International General Aviation — Aeroplanes* and Part III — *International Operations — Helicopters*, Annex 9 — *Facilitation*, Annex 11 — *Air Traffic Services*, Annex 16 — *Environmental Protection, Procedures for Air Navigation Services — Aircraft Operations* (PANS-OPS, Doc 8168), Volume III — *Aircraft Operating Procedures and Procedures for Air Navigation Services — ICAO Abbreviations and Codes* (PANS-ABC, Doc 8400). The proposed amendments have received broad support from States and the Air Navigation Commission (ANC) with an applicability date of 28 November 2024.

1.3 In addition, ATMRPP has undertaken the task to set a global sunset date to cease the use of FPL2012, update the GATMOC (Doc 9854), and develop the guidance for a transition to a globally interoperable TBO environment. The Panel also worked on Version 11 of the TBO Concept Document, which describes the limitations of the current ATM system. The lack of information-sharing between the ATM services provider (ASP) and the airspace user (AU), within ASP systems and between ASPs, creates inconsistent and inaccurate trajectory predictions, resulting in decision-making process that is based on local trajectories that does not collaborate with adjacent and air navigation services providers (ANSPs) that are in the air traffic flow chain. To facilitate TBO at the global level, a consistent and harmonized understanding of the degree of TBO capability and operational readiness is necessary.

2. DISCUSSION

2.1 In 2020, Canada, Japan, Singapore and Thailand joined the Multi-Regional TBO (MR TBO) Demonstration Project led by the United States. Over the next three years and through a multi-phase approach, the team identified, validated and demonstrated the TBO concept, along with its required technical capabilities and resulting operational values. Phase 1 of the project focused on developing operational scenarios, determining baseline technical capabilities, and executing risk reduction activities. During Phase 2A, partners finalized operational scenarios and technical capabilities, agreed on priorities, and conducted full end-to-end demonstration of prioritized scenarios in a lab environment. In Phase 2B, operational scenarios and lessons-learned were used to develop and execute a live flight demonstration to validate requirements and operational values of the MR TBO concept and operations. Live flight demonstration also enabled each partner to confirm regional priorities while staying in alignment with the global TBO concept.

2.2 To further validate the TBO concept continuing from the MR TBO project and to expand the participation, China, Indonesia, Japan, New Zealand, Philippines, Singapore, Thailand, United States, Civil Air Navigation Services Organisation (CANSO) and International Air Transport Association (IATA), signed a letter of intent titled APAC TBO Pathfinder project in 2023, where the participants agreed to jointly develop the TBO concept, requirements and deployment timeline for the APAC region. Subsequently, the Republic of Korea and Viet Nam joined the project while Australia, India and Hong Kong, China participated as observers.

2.3 During the kick-off meeting of the APAC TBO Pathfinder Project, which was held from 3 to 5 April 2024, the participants shared about their TBO deployment plans with its enablers, including SWIM, FF-ICE and connected aircraft concept. Exchanges during the kick-off and numerous past virtual meetings and over email, culminated into an agreement on the goals, high-level deliverables and associated timelines. Three workgroups were formed to divide and further work on the deliverables, as follows:

- a) Workgroup 1 will consolidate and develop educational materials to harmonize understanding of the global TBO concept, requirements, operational values and deployment timeline;
- b) Workgroup 2 will harmonize operational values, and develop TBO scenarios and city-pairs to validate common operational values through laboratories demonstrations and trials; and
- c) Workgroup 3 will develop and harmonize common metrics and methodology for evaluation of expected benefits as well as post-deployment changes in flight and system performance and agree on a regional deployment timeline.

2.4 Leveraging the experience and lessons gained from MR TBO demonstration, the APAC TBO Pathfinder Project continues the exploration and development of APAC's journey towards TBO realization. The participants have prioritized work on deployment of mature TBO technical enablers. The following are required for a successful realization of TBO:

- a) accurate and consistent information that is collaboratively managed and shared across all ATM stakeholders; this global information management and exchange is known as System-Wide Information Management (SWIM);
- b) collaborative decision-making framework, processes and protocols to enable dynamic modifications to flown trajectories that are agreed-upon by all stakeholders; this flight trajectory management and exchange is known as the Flight and Flow Information for a Collaborative Environment (FF-ICE); and
- c) ability to collaboratively and seamlessly negotiate and exchange information between aircraft/flight deck, flight operations center, and ATM systems and actors; the concept that describes the exchange of a rich set of information between the aircraft and ground automation to improve operational awareness and decision-making is known as the Connected Aircraft.

2.5 Within APAC, it is expected that there would be different levels of readiness and the ability to manage air traffic within a mixed-mode environment would be essential. While this is so, States and Regions should focus on expediting the planning and implementation of mature TBO technical enablers whilst ICAO continues in their work to focus on regional and global implementation harmonization.

3. **CONCLUSION**

3.1 APAC TBO Pathfinder Project is a significant undertaking in the APAC Region. The participants aim to coordinate and harmonize efforts to operationalize the global TBO concept that contributes to the seamless regional ATM in Asia and Pacific.

3.2 The Conference is invited to:

- a) note the progress of development and implementation of TBO in APAC;
- b) urge regions and States to commit resources and participate in ICAO activities that aim to expedite and harmonize the implementation of TBO globally; and
- c) support ICAO in expediting its work programme on TBO and its enablers, including the development of a plan and timeline for operationalization of TBO service provision as an input to Asia/Pacific Seamless ANS Plan.

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