International Civil Aviation Organization

First Meeting of the APAC ANSP Committee (AAC/1)

Bangkok, Thailand, 17 – 18 April 2023

Agenda Item 3: Work Program

MULTI-REGIONAL TBO DEMONSTRATION

(Presented by Japan, Singapore, Thailand, and USA)

SUMMARY

This paper presents an overview of Multi-Regional TBO Demonstration, a collaborative project undertaken by Japan, Singapore, Thailand, USA, and Canada to validate TBO concept as well as to showcase the TBO operational values and key capabilities, both operational and technical, required to support TBO. Leveraging the experience gained from this Demonstration, the Meeting is encouraged to collaborate on establishing the crucial TBO building blocks to enhance ATM operations and to support the realization of TBO in the Asia/Pacific region.

1. INTRODUCTION

1.1 ICAO Doc 9854 Global Air Traffic Management Operational Concept (GATMOC) presents the vision to achieve an interoperable global ATM system, for all users during all phases of flight, that meets agreed levels of safety, provides for optimum economic operations, is environmentally sustainable, and meets national security requirements (§ 1.1.1). The resultant outcome envisioned is known as Trajectory-Based Operation or TBO. To realize TBO, the global ATM system needs to be the one that:

a) Considers the trajectory during all phases of a flight and manages the interaction of this trajectory with other trajectories or hazards to achieve the optimum system outcome, with minimal deviation from the user-requested flight trajectory; the mechanism for flight trajectory exchange and interactions across ATM stakeholders is known as Flight and Flow Information for a Collaborative Environment (FF-ICE); and

b) Is underpinned by a global information utilization, management, and exchange to support holistic, cooperative, and collaborative decision making where the diverging expectations and interests of all members of the ATM community are balanced; the global information system is known as System-Wide Information Management (SWIM).

1.2 In other words, TBO will fundamentally bring about a new paradigm of cooperation in ATM, enabled by timely exchange of harmonized operational data not only between ANSPs but also between ANSPs and airlines. This is different from the current ATM operations in which each ANSP manages flight paths within its ATS airspace, without a systemic mechanism to harmonize flight trajectories across ATS airspaces to achieve optimum system outcome.

2. DISCUSSION

2.1 The ICAO global TBO concept and related capabilities are being matured and progressively implemented in some regions of the world. As part of the global effort, Japan (Japan Civil Aviation Bureau (JCAB)), Singapore (Civil Aviation Authority of Singapore (CAAS)), Thailand (Aeronautical Radio of Thailand Ltd. (AEROTHAI)), USA (Federal Aviation Administration (FAA)) and Canada (NAV CANADA) have put together the collaborative effort to conduct Multi-Regional TBO Demonstration (MR TBO Demo). The main objectives of this demonstration also include (*i*) to explore the impacts of TBO within the context of modernization initiatives and (*ii*) to support the development of information exchange standards and related ICAO materials.

2.2 MR TBO Demo is carried out in two phases. In Phase 1 (May 2020 to July 2021), the operational scenarios between city pairs in Japan, Singapore, Thailand, USA and Canada, were planned, and the necessary TBO capabilities of each ANSP partner to conduct the demonstration were established. Phase 2 (July 2021 to June 2023), which is ongoing, is the execution of the demonstration. Details of the MR TBO Demo were previously presented at SWIM/TF/5 as well as APANPIRG/32 in 2021 and 57th DGCA Conference in 2022 (see Annex for details).

2.3 The MR TBO partners leverage on draft provisions and guidance materials developed by ICAO Panels such as Information Management Panel (IMP), ATM Requirements and Performance Panel (ATMRPP), and the APANPIRG contributory body – SWIM Task Force (TF), to design the required capabilities and support the conduct of the operational scenarios. As per para 1.1.b), the information management and exchange setup amongst the ANSPs for the purpose of the demonstration are in accordance with the SWIM concept.

2.4 In addition, the cooperative management of the flight trajectory in TBO will entail new information needs for flight planning, flow management, and trajectory management. For this purpose, ATMRPP is developing FF-ICE to set these information requirements. The MR TBO partners leverage on the FF-ICE concept and implementation guidance being developed for the demonstration setup as well.

2.5 Building on the insights gained from the MR TBO Demo, the partners have been conducting several activities under the APANPIRG contributory bodies, i.e. SWIM TF and FF-ICE Operational Requirements Small Working Group (SWG), to share knowledge with the aim of establishing the key TBO enablers in the Asia/Pacific region.

2.6 With the adoption of APANPIRG/33 through Conclusion APANPIRG/33/9 on the 2024-2030 Asia/Pacific SWIM implementation timeframe and the ongoing work of FF-ICE Operational Requirements SWG, it is timely for Asia/Pacific ANSPs to collaborate on building these two capabilities to enhance ATM operations towards the goal of implementing TBO in Asia/Pacific. SWIM and FF-ICE are key building blocks to the realization of TBO in Asia/Pacific and as such their implementation should be prioritized.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) provide guidance and collaborate on establishing the key TBO building blocks, i.e. SWIM and FF-ICE, to support the development and realization of TBO in Asia/Pacific; and

c) discuss any relevant matters as appropriate.

…….

ANNEX – DETAILS OF THE MULTI-REGIONAL TBO DEMONSTRATION (MR TBO DEMO)

1. MR TBO Demo is divided into two phases:
   - Phase 1 (May 2020 – July 2021)
     - Planning and developing activities for TBO demonstrations
     - Establishing (baseline) technical capabilities
     - Establishing industry and international partnership
   - Phase 2 (July 2021 – June 2023)
     - Execution of MR TBO Demo
       + Phase 2A (July 2021 – May 2022): Lab Demonstration
       + Phase 2B (June 2022 – June 2023): Live-Flight Demonstration

2. Building on the Mini Global Demonstrations, the SWIM in ASEAN Demonstration as well as various concept validation activities, the gate-to-gate operational scenarios were developed under the MR TBO Demo with the aim to not only validate the TBO concept but also highlight the TBO operational values, including:
   - Enhanced predictability – A common plan (strategy) shared among stakeholders enhances predictability and improves operations by mitigating confusion with stakeholders operating off the same trajectory;
   - Alignment of strategic plan and tactical actions – Sharing, management, and use of the trajectory as a common framework help create alignment of strategic plan and tactical actions;
   - Increased, reliable flexibility – Sharing, management, and use of the trajectory as a common framework among stakeholders provide flexibility in accommodating trajectory changes while maintaining business objectives;
   - Improved strategic planning – Improved planning (incorporating out-of-zone traffic) helps mitigate deterministic delay factors, improve network performance and more equitably distributes delays; and
   - Decrease uncertainty – Improved trajectory accuracy, obtained from a timely information sharing and aligning tactical actions with strategic plan, decreases uncertainty in the system.

3. Following the design of operational scenarios, the key TBO operational and technical capabilities were identified and the MR TBO Lab Demonstration was conducted in May 2022 to mature and demonstrate these features such as:

Operational Capabilities	Technical Capabilities
• Pre-departure and post-departure trajectory planning, negotiation, and revision • Seamless exchange of trajectory information update among stakeholders • Enhanced demand and capacity balancing • Improved collaborative decision making	• FF-ICE/R1 services • Initial FF-ICE/R2 services • SWIM technical infrastructure and SWIM information services • Secured information exchange in standardized data formats • TBO clearance delivery • Connected aircraft

Additionally, the operations in mixed-mode environment, where the level of TBO capabilities among ATM Service Providers (ASPs) and Airspace Users (AUs) is different, were also exhibited in the MR TBO Lab Demonstration.

4. Significant lessons learned so far include:

- TBO is about sharing, maintaining, and using trajectories as common references across stakeholders. However, further development and refinement on several artifacts, e.g., the tactical/strategic integration, processing of agreed trajectory by downstream ASPs, are still needed;
- The globally standardized information exchange models are foundational to the success of TBO;
- The continued evolution of the Connected Aircraft is required to enable the sharing of more information among stakeholders, allowing the active participation of flight crews in the collaborative decision making.