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Agenda Item 5: ATM and CNS Systems Modernization

**PROGRESS OF TBO PATHFINDER DEVELOPMENT IN THE
ASIA/PACIFIC REGION**

(Presented by Indonesia on behalf of Hong Kong China, Japan, Malaysia, New Zealand, Philippines, Republic of Korea, Singapore, Thailand, United States, Viet Nam and International Air Transport Association (IATA))

SUMMARY

This paper presents progress by the Asia-Pacific (APAC) Trajectory-Based Operations (TBO) Pathfinder Project (Pathfinder). Pathfinder was initiated under the APAC Air Navigation Service Provider (ANSP) Committee (AAC) to develop pathways for implementing the ICAO Global TBO concept in the region.

While the past activities have been more ANSP-focused, with the focus for 2026 being FF-ICE/Release 2 (FF-ICE/R2), it is timely to involve Airspace Users (AUs) as key stakeholders to progress TBO towards deployment.

1. INTRODUCTION

1.1 Pathfinder involves the ANSPs of China, Hong Kong China, Indonesia, Japan, Malaysia, New Zealand, Philippines, Republic of Korea, Singapore, Thailand, United States of America and Viet Nam, along with CANSO and IATA, who have agreed to define, develop and demonstrate the concept of operations and requirements for TBO in the APAC region.

1.2 TBO represents a paradigm shift in air traffic management by proactively and collaboratively managing aircraft trajectories across four dimensions: latitude, longitude, altitude, and time. The degree of change needed to implement full TBO-based operations globally is significant, and ICAO is currently focused on harmonizing global implementation. Meanwhile, States and regions could focus on expediting the planning and implementation of the technical building blocks, like System-Wide Implementation Management (SWIM) and Flight and Flow Information for a Collaborative Environment (FF-ICE) to prepare for TBO.

1.3 Through the participation of ANSPs of States/Administrations and International Organisations, Pathfinder aims to:

- a) raise TBO awareness in the region;
- b) provide greater clarity on TBO requirements through workshops / table-top exercises / demonstrations; and
- c) analyse benefits and develop a TBO roadmap for APAC.

1.4 Throughout 2025, Pathfinder efforts were focused primarily on FF-ICE/R1 application. A summative report of the efforts to support the implementation planning efforts among ANSPs was presented to ATM/SG/13 and summarised as follows:

- a) completion of the first edition of the TBO communication material in July 2025, followed by circulation of the copy to the Pathfinder members. The material will be uploaded on the AAC website for wider accessibility;
- b) completion of stakeholder engagement with Viet Nam in July 2025; Key stakeholders including Viet Nam's ANSP, airlines, airport and regulators participated in this engagement session and all gained appreciation on the TBO concept, its key building blocks and the key benefits from deploying TBO;
- c) completion of the FF-ICE/Release 1 (R1) laboratory demonstration (lab demo) in July 2025 where Pathfinder ANSPs participated actively to build up their technical capability to ready themselves for the deployment of SWIM and FF-ICE/R1 services; and
- d) completion of the APAC TBO roadmap where ATM/SG/13 agreed as Conclusion ATM/SG/13-6 to incorporate the roadmap into the 2026 revision of *Asia/Pacific Seamless ANS Plan*.

1.5 For 2026, with the focus moving to FF-ICE/R2, Pathfinder will continue its trajectory to reinforce the long-term vision of full TBO implementation which will require active involvement of the Airspace Users (AUs).

2. DISCUSSION

Learning and Advocacy

2.1 In 2026, Pathfinder will work to update the TBO communication material with two elements:

- a) TBO roadmap – to provide a pathway towards deployment in APAC; and
- b) perspectives from AUs in APAC.

2.2 On 22 June 2026, Pathfinder conducted a stakeholder engagement session in the Philippines which involved their key stakeholders.

2.3 To gain buy-in from AUs, IATA conducted two regional webinars in late July 2026, to raise awareness of TBO and FF-ICE for AUs. These webinars primarily targeted operational and technical subject matter experts, with an additional separate high-level webinar delivered specifically for executive levels in airlines.

Capability Build-up

2.4 In preparation for the FF-ICE/R2 lab demo, Pathfinder facilitated a series of technical interchange meetings (TIMs), table-top exercises (TTXs) and online preparatory meetings. Thailand hosted the first TIM in January 2026 to develop the technical criteria for FF-ICE/R2 lab demo participation and determine the Pathfinder members' level of involvement in the lab demo. Japan hosted the first FF-ICE/R2 TTX in February 2026 in conjunction with the Pathfinder Project Meeting #3 where participants were able to deep dive into discussion topics such as mixed mode operations, technical architecture and FF-ICE/R2 processes through the pre-defined operational scenarios. The Philippines hosted the second FF-ICE/R2 TTX, to further refine the FF-ICE/R2 processes using the pre-defined operational scenarios. Issues and discussion points raised in the earlier TTX were clarified and the SWIM technical architecture was finalised with the consensus of the participants.

2.5 Pathfinder is working towards the conduct of the FF-ICE/R2 lab demo in March 2027, to be hosted by Indonesia. Three operational scenarios will be showcased:

- a) key difference between a full FF-ICE/R2 and today's tactical 'in flight' planning processes in revising airborne trajectory, in response to weather constraints;
- b) coordination of airborne trajectory revisions and management of delays across multi-leg operations in a mixed mode environment of FF-ICE/R2 and FF-ICE/R1 operations, due to volcanic eruption and ATFM constraints; and
- c) strategic in-flight trajectory negotiation to facilitate early compliance with ATFM measures between two flights departing from different aerodromes but operating on the same route, within the same timeframe.

2.6 Importantly for this phase of TBO on FF-ICE/R2, the TIMs and TTXs increasingly included the active participation of AUs, specifically, All Nippon Airways, Bangkok Airways, Cathay Pacific, Cebu Pacific Air, Garuda Indonesia, Japan Airlines, Philippines Airlines, Philippines Air Asia, Singapore Airlines, SF Airlines and Thai Airways. These AUs enhanced the realism of the operational scenarios. With the support of IATA, Pathfinder will continue to support the capability build-up of the AUs through their participation in the subsequent planned activities.

Benefit Analysis

2.7 In 2026, Pathfinder is developing two trajectory analysis methodologies to determine potential benefits of TBO for city pairs, and ANSP centric analysis. Upon completion, both methodologies and relevant results will be documented within the TBO benefits report.

Conclusion

2.8 The work of Pathfinder allows members and participants to gain better understanding of both the global and regional developments on SWIM and FF-ICE. This is an essential step given impending regional deployment timelines of SWIM (by 2030) and FF-ICE/R1 services (by 2032).

2.9 For a meaningful outcome of the FF-ICE/R2 lab demo, stakeholder engagement and involvement is crucial, especially AUs. FF-ICE/R2 will extend trajectory negotiation beyond current flight dispatch (as in FF-ICE/R1 application) and tactical airborne change (as in pilots' direct communications with ATC) to strategic negotiations including pilots, flight operations units and ATM systems, altering the roles and responsibilities of all.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) note the progress and updates of the APAC TBO Pathfinder Project;
- b) support State's key stakeholders such ANSPs and airlines to:
 - i) raise awareness on operational benefits of TBO in the region;
 - ii) work towards regional deployment of SWIM by 2030 and FF-ICE/R1 services by 2032; and
- c) discuss any relevant matters as appropriate.

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