International Civil Aviation Organization

Sixth Meeting of the Asia/Pacific Air Traffic Management Automation System Task Force (APAC ATMAS TF/6)

Bangkok, Thailand 2-4 June 2025

Agenda Item 5: ATM Automation System Implementation Experience by States
5.6. Development of New Technology

EXPERIENCE SHARING ON ATMAS VALIDATION PLATFORM IN TBO APPLICATION

(Presented by China)

SUMMARY

This paper outlines the TBO (Trajectory Based Operations) dual aircraft trial between Urumqi and Daxing in China and details the deployment and relevant test of ATMAS validation platform at Daxing Airport. The validation encompassed uplink of ATM instructions and downlink of airborne flight profiles, which is conducted without compromising ATM operation. The TBO dual aircraft trial establishes technical references and operational experience for TBO implementation in China's civil aviation.

1. INTRODUCTION

1.1 TBO is a next-generation air traffic management operational model proposed by the International Civil Aviation Organization (ICAO). Its core concept involves dynamic sharing of aircraft high-precision four-dimensional trajectories (longitude, latitude, altitude, time) and collaborative decision-making to achieve comprehensive flight monitoring, prediction, and control throughout the entire flight process. This concept breaks down data barriers between air traffic controllers, pilots, and airports, while significantly reducing fuel consumption and carbon emissions through precise trajectory calculations.

1.2 Since 2018, Civil Aviation Administration of China (CAAC) has incorporated TBO into its civil aviation construction outline, promoting phased implementation of technological R&D and application:

a) 2018-2023 R&D Phase: Focused on breakthroughs in I4D trajectory prediction algorithm and flight plan coupling technology.

b) 2024 Validation Phase: Participated in multiple national TBO exploration research and cooperation programs.

1.3 Conducted validation on the Urumqi-Daxing route to address engineering challenges such as data link compatibility and system interoperability. This paper presents the overall implementation plan for this trial, and shares the deployment of the validation platform at Daxing Airport and the TBO experience related to ATM.

2. DISCUSSION

TBO Dual-Aircraft Validation

Overview of the Validation Plan

2.1 The TBO validation adopted a dual-aircraft real-flight testing approach, aiming to expand from single-aircraft ground-air traffic control scenarios to collaborative interaction scenarios between two aircraft. During the validation process, a Boeing 737 and an Airbus A320 (both equipped with AID-EFB capability, FANS 1/A CPDLC, and ADS-C) were arranged to depart from Urumqi Diwopu International Airport and land at Beijing Daxing International Airport. Both aircraft followed the same existing commercial flight routes, flying sequentially with a departure interval not exceeding 30 minutes.

2.2 Responsibilities of Participating Entities in the Validation:：

a) Air Traffic Management Bureau (ATMB):
Issued and received ATC clearances.
Coordinated flight paths, altitudes, and airspace usage for the aircraft.

b) Beijing Daxing International Airport:
Provided on-site facilities and logistical support.
Assisted in the field implementation of validation activities.

c) China Southern Airlines Company Limited (CSA):
Supplied the validation aircraft.
Supported onboard equipment installation, configuration, and crew training。

d) China Electronics Technology Group Corporation (CETC) &The Second Research Institute of CAAC (CAACSRI):
Delivered technical expertise to ensure system performance and stability.

e) Aviation Data Communication Corporation (ADCC)：
Managed real-time data processing, transmission, and analysis.
Provided data-driven insights to validate operational efficiency and system interoperability.

2.3 Specific Validation Components Included:

a) The integration of CPDLC and ACARS ATS for full-phase data link air traffic control,
b) The graphical display of air traffic control instructions on electronic flight bag (EFB) devices,
c) The application of the onboard Extended Projected Profile (EPP) in ATM,
d) The inter-aircraft situational awareness sharing,
e) And flight and flow information for a Collaborative Environment (FF-ICE) between air traffic control and airlines for flight plan coordination during the pre-tactical phase before flight departure.

2.4 The verification related to ATMAS mainly involved the onboard display of air traffic control instructions and the downlink data of the aircraft's predicted trajectory profiles.

Daxing Validation Implementation Plan

2.5 Daxing ATMAS Validation Platform adheres to the principle of "independent deployment with closed-loop functionality".

a) Independent Deployment: A full-process platform covering data access, processing, and display has been established without interfering with operational ATMAS, ensuring the safety of civil aviation air traffic management operations.
b) Simplified Platform: As shown in Figure 1, the platform primarily consists of Surveillance Data Processing Server (SDP), Flight Plan Processing Server (FDP), and Data

Communication Processing Server (DCP). The system integrates CAT062 tracks and flight plans from operational ATMAS while maintaining the interaction with the ground-to-air data link core server of ADCC.

c) New Functions: The platform possesses traditional functions such as surveillance, flight plans, alerts, and human-machine interface, and is additionally capable of receiving and displaying downlink airborne trajectory profile data, as well as uploading control instructions to airborne electronic flight bags.

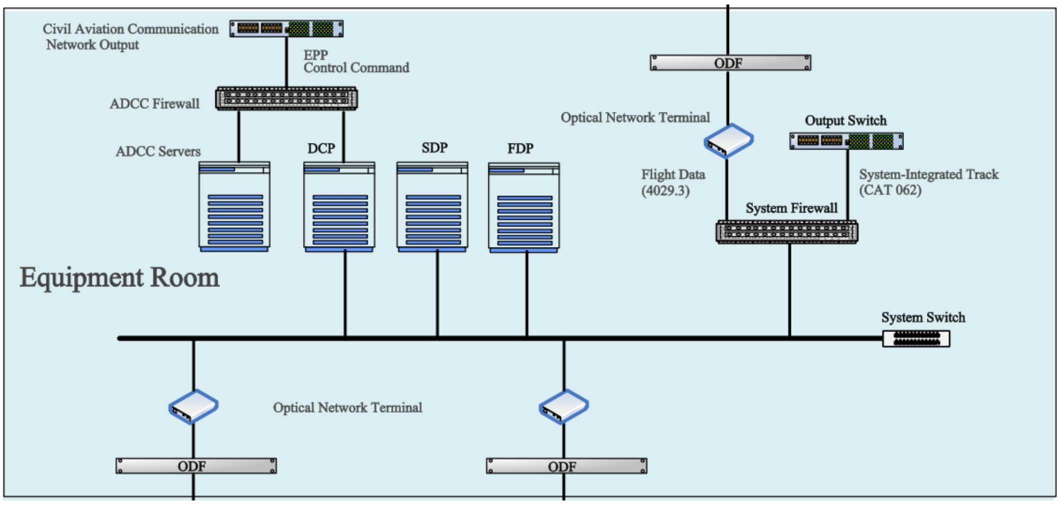

Figure 1 Daxing ATMAS Validation plateform Architecture

2.6 The TBO validation in Beijing area primarily verifies two aspects: downlink/display of EPP messages and uplink of control instructions. As shown in Figure 2, EPP messages are unidirectionally received by ATMAS, while control instructions (e.g., speed adjustments, altitude changes, heading changes, frequency changes) are bidirectional. Specifically, airborne equipment automatically replies with a logical confirmation MAS message upon receiving control instructions, and the flight crew further sends a CDA confirmation message after acknowledging receipt.

Figure 2 Data transmission flowchart

a) EPP messages download: After two aircraft enter the cruise phase, EPP messages are automatically downloaded, containing information such as subsequent waypoint names, latitude/longitude, and estimated arrival times. These messages are transmitted to the ATMAS via the ground-to-air data link. The ATMAS parses the messages and displays the aircraft-downlinked 4D profile on its HMI, which can be compared with the 4D profile ATMAS calculated, as shown in Figure 3 below.

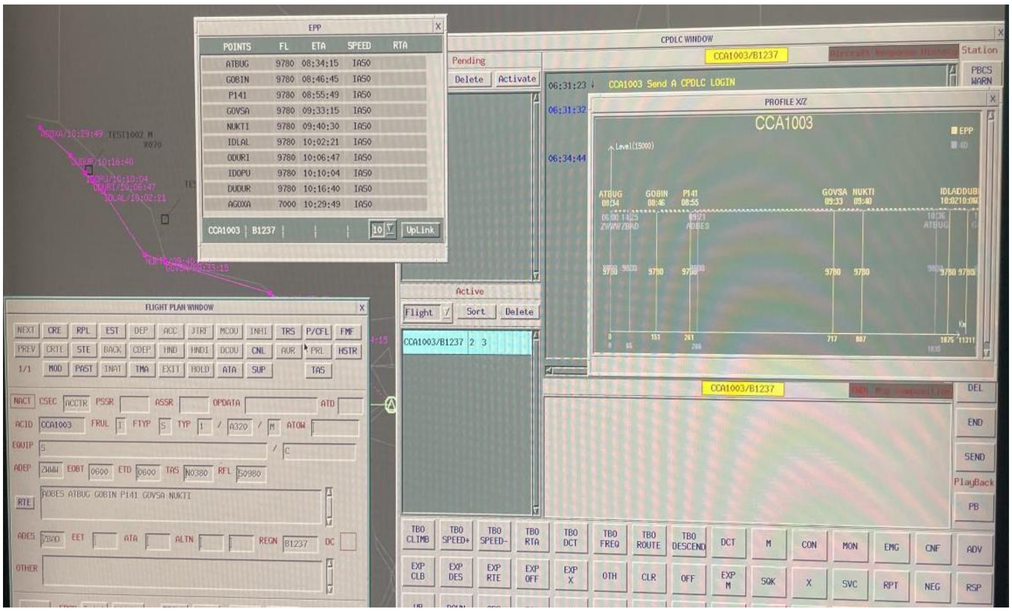

Figure 3 EPP message download

b) Control Command Upload: Controllers input corresponding control commands (e.g., frequency change, speed adjustment, altitude adjustment, direct routing, approach procedures, etc.) in ATMAS, which are then transmitted to the flight crew via the air-ground datalink. As shown in Figure 4 below, after the controller sends a "descend to 3,000 meters" command, the system assembles the corresponding command message and sends it to the crew. The onboard equipment automatically replies with a MAS (Message Acknowledgment System) confirmation message upon receipt. Once the crew acknowledges reception, a CDA (Confirmation of Downlink Acknowledgment) message is returned, notifying the controller that the command has been successfully received by the flight crew.

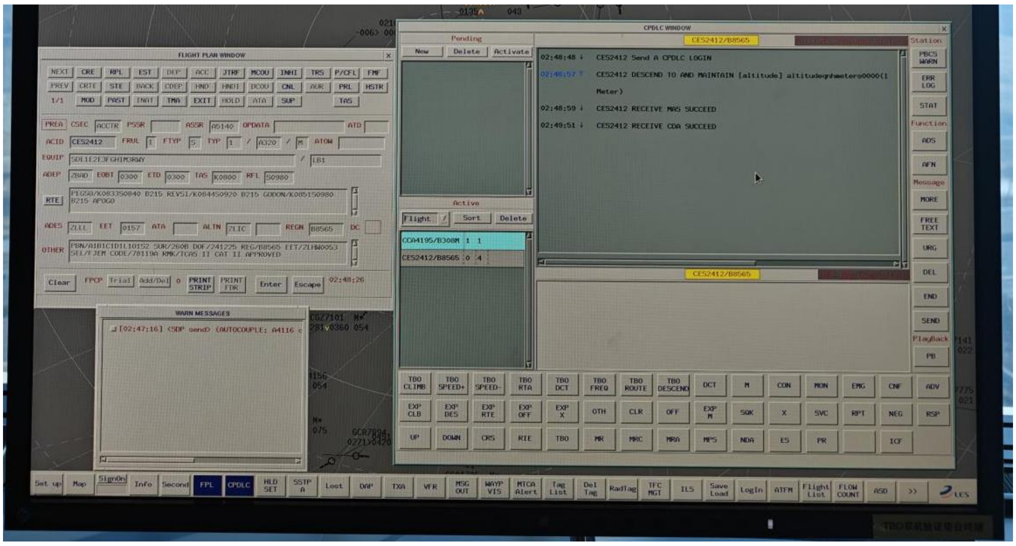

Figure 4 Control Command Upload

2.7 Achievements

The test conducted in Daxing ATMAS validation platform successfully verified multiple digital ATC functionalities, such as trajectory profile download and control command upload. Additionally, the practical operational validation highlighted challenges in implementing TBO, such as the need for ATC system upgrades, providing experience for future technological development and implementation.

Challenges

2.8 The upgrade of current ATM automation systems requires substantial financial investment and involves complex implementation processes. These upgrades must be carried out without disrupting existing ATM operations. Additionally, inconsistent progress in upgrading ATM equipment across regions may face the challenge of system compatibility issues, hindering the comprehensive adoption of TBO technology.

2.9 The implementation of TBO depends on stable, high-speed data communication links. Currently, the coverage and reliability of these links need further improvement. Building a more extensive and stable network requires coordinating resources across stakeholders, with high construction costs. Furthermore, ensuring data security (e.g., preventing tampering or leaks during transmission) remains a critical priority.

2.10 TBO necessitates significant updates to traditional ATC procedures, which are based on voice communication and radar surveillance. These legacy methods differ fundamentally from TBO's data link communications and 4D trajectory collaborative decision-making model. Controllers must undergo retraining to adapt to new procedures, and the transition will require extended time for gradual implementation.

3. **ACTION BY THE MEETING**

3.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matter as appropriate

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