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Agenda Item 4
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International Civil Aviation Organization

SEVENTH MEETING OF THE ASIA/PACIFIC AIR TRAFFIC MANAGEMENT AUTOMATION SYSTEM TASK FORCE (ATMAS TF/7)

Bangkok, Thailand 2-4 June 2026

Agenda Item 4: ATM Automation System Implementation Experience by States

4.6 Development of New Technology

ATMAS TESTING AND EVALUATION CLOUD PLATFORM INTEGRATING VIRTUALIZATION, HYPER-CONVERGENCE, AND CLOUD DESKTOP TECHNOLOGIES

(Presented by China)

SUMMARY

To address the limitations of traditional ATM automation system testing platforms—such as rigid resources and limited scenarios—the ATMBTC of China has developed a next-generation testing and evaluation cloud platform. It integrates virtualization, hyper-convergence, and cloud desktop technologies. The platform enables resource pooling and elastic provisioning, supports parallel testing of multi-vendor, multi-version systems and high-fidelity scenario simulation. It significantly improves testing efficiency and flexibility, providing strong support for the safe operation and evolution of China's civil aviation ATM systems.

1. INTRODUCTION

1.1 ATMB Technical Center is an important institution for the research, validation, and promotion of civil aviation ATM technologies in China. Its ATM Testing and Validation Laboratory is responsible for the testing and evaluation of key technologies such as automation systems, to ensure safe and stable operation and continuous upgrades.

1.2 Traditional ATM automation system testing platforms typically use a physical architecture that is either equivalent to or scaled down from operational systems. They have shortcomings such as high hardware investment, fixed system versions, long deployment time, and lack of resource flexibility. Such platforms cannot efficiently construct full-scale, high-traffic, multi-unit collaborative, or main-backup synchronization test scenarios. They also cannot fully support interactive verification between multiple systems, limiting the breadth and depth of testing.

1.3 Under China's smart ATM development framework, ATMBTC has led the design and construction of a new-generation testing and evaluation cloud platform. This platform aims to build a standardized and intelligent testing environment with "full version, full scenario, and full data" capabilities. It supports the rapid iteration and safety verification of ATM automation systems.

1.4 This paper introduces the system architecture, core capabilities, implementation progress, and key role of this platform in improving the testing and validation level of ATM automation systems.

2. DISCUSSIONS

Overall Architecture of the Platform

2.1 The platform adopts an integrated architecture of "hyper-converged base," "cloud desktop service," and "specialized testing subsystem":

1) The hyper-converged base integrates high-performance computing, storage, and network hardware resources to build a unified virtualized resource pool. This enables elastic allocation, rapid deployment, and efficient management of computing and storage resources.

2) The cloud desktop system fully virtualizes traditional physical control positions through efficient desktop virtualization protocols. Testers can remotely access from any authorized terminal and get the same operating experience as a local physical position. This enables agile deployment, flexible projection, and one-click switching of test positions.

3) The testing service subsystem integrates self-developed tools such as high-degree-of-freedom simulation sources, data dispatch and forwarding, full system monitoring, automated stress testing, and track comparison. It provides comprehensive and standardized technical support for building test cases that closely mimic real operational scenarios.

Performance Characteristics of the Platform

2.2 The platform has 2016 physical CPU cores, capable of supporting 39,200 virtual CPU cores. It has 2000 TB of mechanical storage and 300 TB of solid-state storage. It can simultaneously store more than 20 sets of ATM automation system environments, support 400 nodes running in parallel, and provide more than 30 flexibly configurable test positions.

2.3 The deployment and switching time for a single automation system in a virtual environment is less than 5 minutes. Test position switching is at the second level. The overall platform full-function start-up time is less than 10 minutes, greatly improving testing preparation and execution efficiency.

2.4 It supports simultaneous simulation and sharing of no less than 4,096 real-time surveillance targets with data link capability and 15,000 flight plans. The script storage capacity is no less than 5,000. It can accurately reproduce complex operational scenarios such as peak arrival/departure hours, control handovers, and emergency handling.

2.5 It enables parallel deployment, synchronized operation, and interactive testing of cross-vendor, multi-version ATM automation systems in a unified cloud environment. This facilitates system compatibility assessment, functional comparison analysis, and collaborative operation verification.

Implementation Progress and Application Results of the Platform

2.6 As of the end of 2025, Phase I of the platform has passed acceptance and is officially in use. Based on the new architecture, the platform has the following main capabilities:

1) Rapid deployment and flexible switching. The platform has completed cloud deployment of 20 mainstream ATM automation systems from multiple regions in China, covering 1,235 system nodes (including 20 physical positions). It can simultaneously support parallel testing of two large area control center systems or four medium terminal control systems. Automation system types and control positions are configured on demand and switched at the second level through software-defined methods.

Fig.1This shows the automation system position selection interface based on cloud desktop technology. The upper right corner of the interface shows the currently selected system (e.g., "Lesi - East China"). The central 4×4 area is the position selection area. Double-clicking quickly switches to the corresponding position. It also supports operations such as power-on, restart, and snapshot for the positions.

2) Based on the cloud architecture, various PaaS tools can be deployed. Through simulation sources and a data forwarding platform, simulated data such as radar, flight plans, messages, weather, and special situations are injected uniformly into multiple isolated systems under test. This reproduces complex scenarios such as peak arrival/departure hours and control handovers. It also supports cross-system interface simulation. Built-in tools such as track accuracy comparison, stress testing, and stability testing quantitatively evaluate system processing accuracy and stress resistance. This forms a closed-loop testing system from scenario generation to quantitative evaluation.

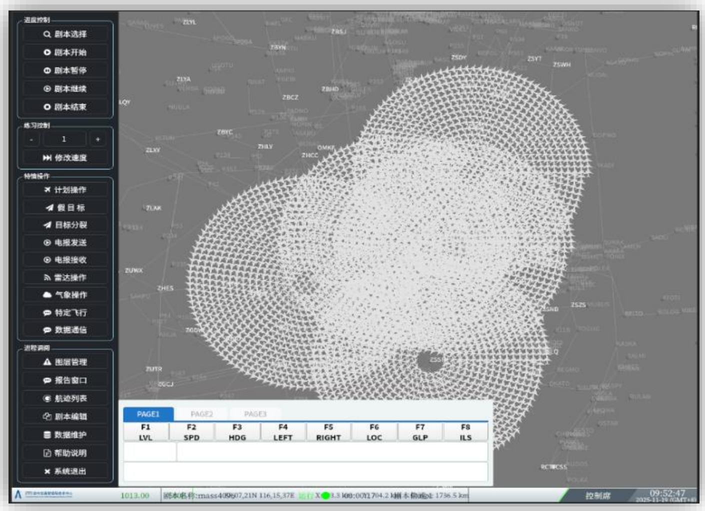

Fig.2 This shows the main interface of the simulation source system deployed on the cloud platform. The left side menu includes function areas such as progress control, contact control, special situation operations, and flight plan viewing. Special situation operations include simulation of false targets, split targets, weather, radar simulation, etc. The main interface visually presents batch simulation of 2,048 targets.

3) Supports remote collaborative testing and resource sharing. Using China's civil aviation communication network, the platform will expand cross-region collaborative testing and validation capabilities. It supports testers at different nodes to remotely access the same simulation environment for joint testing and emergency drills. It integrates and shares simulation data and computing resources, improving the efficiency of multi-user collaborative validation.

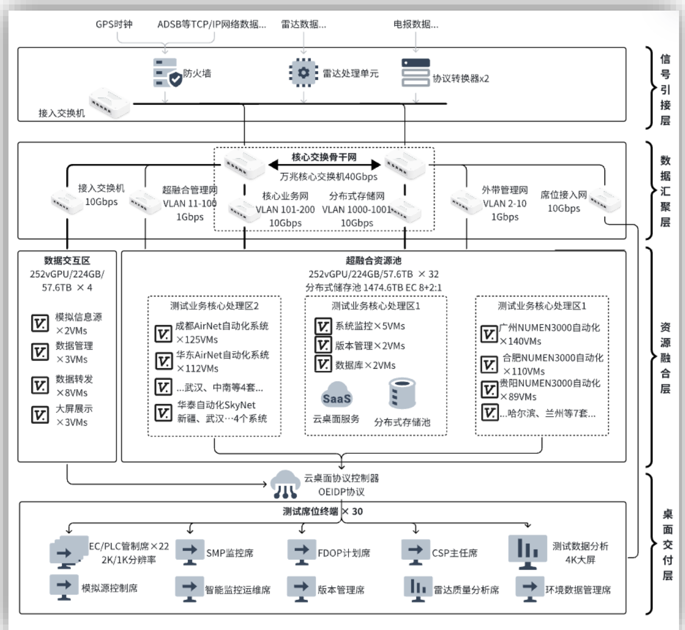

Fig.3 The platform adopts a four-layer decoupled architecture: The signal access layer securely accesses multi-source data. The data aggregation layer ensures isolated forwarding through redundant 10G networks. The resource fusion layer, based on hyper-converged pooled resources, deploys simulation sources and 20 automation systems in parallel, with SDN achieving three-network isolation. The desktop delivery layer provides 30 virtual positions based on cloud desktop. The four layers work together to provide integrated support for full-function validation, complex simulation, and new technology trials.

2.7 The platform will support ATM automation systems in the following key activities:

1) System full-function and reliability validation: In an environment that highly restores real network topology and node scale, complete functional testing of new software versions and

patches is completed, as well as reliability verification such as system redundancy switching and degraded operation.

2) Complex interaction and collaborative scenario testing: Supports C-class control handover between automation systems, main-backup system data synchronization, and integration and interaction testing with external systems such as A-SMGCS. This solves the difficulty of constructing such scenarios in the past.

3) Provides a safe and isolated pre-research and demonstration environment for new technologies and functions in the ATMAS field, such as trajectory-based operations and advanced conflict warning. It supports rapid prototype verification, operational trials, and iterative optimization of technical solutions.

2.8 The construction of this platform has achieved several important innovations in China's ATM testing and validation infrastructure:

- Realizes cloud integration and parallel testing of cross-vendor automation systems.
- Uses cloud desktop technology to achieve fully virtualized and efficient management of control positions.
- Achieves unified reuse and scheduling of real-time ATM data at the software level.
- Integrates various automated testing tools and adapts to new-generation hardware.

<u>Conclusion</u>

2.9 The successful practice of this testing and evaluation cloud platform is a key achievement in the digital and intelligent transformation of China's civil aviation ATM automation system testing and validation infrastructure. Through resource pooling, flexible provisioning, and scenario simulation, the platform systematically overcomes the limitations of traditional testing modes, such as rigid resources and single scenarios. It significantly improves testing agility, realism, and coverage. It provides efficient support for the safe operation and continuous upgrade of ATM systems.

2.10 This platform not only achieves a systematic leap in testing and validation capabilities but also provides an agile and reliable cloud-based validation environment for the rapid incubation and safe introduction of future ATM technologies. Going forward, China's civil aviation will continue to leverage the advantages of cloud platform technology. It will deploy integrated platforms at operational sites that combine maintenance, training, and emergency response needs. This will support resource-efficient management and operational model innovation for ATM systems.

3. ACTION BY THE MEETING

3.1 The meeting is invited to：

a) note the progress made by China in building and using the ATM automation system testing and evaluation cloud platform；

b) exchange views on the technological innovation of the testing and validation platform and its role in improving ATM system safety and efficiency.

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