International Civil Aviation Organization

Fifth Meeting of the Asia/Pacific Air Traffic Management Automation System Task Force (APAC ATMAS TF/5)

Chengdu, China, 5 – 7 June 2024

Agenda Item 4: ATM Automation System Implementation Experience by States

4.5 Development of New Technology

THE REQUIREMENTS AND EXPECTATIONS OF THE NEXT-GENERATION ATMAS

(Presented by China)

SUMMARY

This paper presents a solution of the next-generation air traffic management automation system (ATMAS) to address current system issues and future operational challenges.

1. INTRODUCTION

1.1 ATMAS, designed to assist controllers with target tracking, flight information management, alert and ATC clearance support services, plays a crucial role in ATC operation. However, while the complexity of system functionality increases, systemic risks in software architecture pose a primary threat to operational safety. Meanwhile, it becomes a significant challenge for the ATMAS to assist controllers in enhancing operational efficiency and alleviating their workload further.

1.2 A solution of the next-generation ATMAS has emerged gradually by analyzing existing systems and operational requirements. It's expected to undergo multiple transformations, such as the composition and implementation of computer systems, software architecture, functionalities, and the relationship between systems to meet the development of operational requirements.

2. DISCUSSION

Goals

2.1 The next-generation ATMAS will implement user-defined system functionalities instead of system type-defined functionalities, such as the ATC and the Tower automation system. It will be more adaptable to the tasks and methods of the ATC operation and have flexibility in configuring control procedures. The development of the next-generation ATMAS will obey the description of the Aviation System Block Upgrades to provide standardized services for global flight. At the same time, it will pursue an independent and autonomous development path tailored to local conditions. The next-generation ATMAS will be deeply and widely involved in the control operation process, assist controllers, gain their trust, and promote

the enhancement of human roles. It aims to achieve a symbiotic ecosystem of humans and machines as a "double helix".

Operational Concept

2.2 The next-generation ATMAS supports substituting human-machine interaction for human-to-human interaction among ground personnel and between ground and air to alleviate the controllers' workload. It also supports ATMAS users in shifting their main work from tactical interval management to pre-tactical flow management by transforming flexible and continuous capacity/flow orders and spatial-temporal resource allocation intentions into four-dimensional trajectory instructions for aircraft. Hence, controllers no longer need to devise instructions for individual aircraft through their deliberation. It also supports any role in accessing the service anytime and anywhere, under policies and permissions.

Key Elements

2.3 The next-generation ATMAS will be built upon multiple interconnected local data centers at operational sites, which manage and configure computing, network, and storage resources through a cloud service. This setup not only meets the requirements for remote disaster recovery but also aims to reduce network loads. It’s designed with service-oriented architecture (SOA) to isolate the impact of service failures and enhance flexibility and reliability. It will also implement the Microservices cluster to address the highly iterative demands of human-machine interaction of operational management.

2.4 The next-generation ATMAS's functionalities will be based on three data objects: flight, airspace, and human-made data. These are supposed to form the system's core, considering that describing exactly each event in control operations requires information from these three elements. Additionally, they serve as conditions for data validation for each other.

2.5 The next-generation ATMAS can translate constraints such as operational rules, control objectives, airspace condition changes, and flight task supplies into trajectory instructions for each flight about to enter the specified airspace range. To execute this process, it equipped a series of Capacity-Flow-Trajectory models (CFT) trained through big data. The CFT models, as a service, assist controllers in understanding the effects of instruction intentions and provide support during negotiations between operational roles.

2.6 The next-generation ATMAS would utilize 'spatial computing' technology to associate processed information with real-world targets and capture hand and eye movements for human-machine interaction in visual or equivalent visual operating scenarios, such as in the tower. Tower controllers no longer need to look down at screens to access relevant information or prompts. In scenarios beyond the visual range, it presents the air traffic situation in three-dimensional space through virtual reality technology (VR). It will support natural language processing for users and machine interaction, including controllers, equipment maintainers and operational managers.

Exploration

2.7 Information from multiple teams has revealed the studies of the migration verification of ATMAS towards virtualized and cloud-native architectures. According to the problems encountered in the results, the benefit of virtualized ATMAS would be limited, while there is no change in software and services architecture. Therefore, the solution of the next-generation ATMAS is unlikely to prioritize the change of computer system architecture in the roadmap.

2.8 Some projects in the roadmap are going on as follows. An important task is establishing core data object models from business processes and data frame perspectives based on the SOA method, which may span several years. A study on the impact of operational data on the accuracy and certainty of four-dimensional trajectory predictions is underway. It contributes to the establishment of more precise trajectory prediction models. Another study will verify whether VR technology can assist controllers in enhancing human-machine interaction capabilities.

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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