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

4.4 Integration with External Systems

IMPLEMENTATION AND APPLICATION OF DATA EXCHANGE BETWEEN ATM INFORMATION SYSTEMS

(Presented by China)

SUMMARY

As China's air traffic volume rises, the need for robust and efficient Air Traffic Management (ATM) systems has become increasingly critical. Consequently, China has developed and implemented several advanced ATM information systems, including the ATMAS, A-SMGCS and ATFM. This paper introduces the technical implementation, functions, and significance of the data exchange between these systems. Interfacility data exchange reduces the burden on controllers to operate multiple systems, enhances operational efficiency and ensures safety in increasingly congested airspace.

1. INTRODUCTION

1.1 Air Traffic Management (ATM) information systems, such as the Air Traffic Management Automatic System (ATMAS), Advanced Surface Movement Guidance and Control Systems(A-SMGCS), and Air Traffic Flow Management (ATFM), have been deployed and put into operation in China helping controllers to manage air traffic. Despite the significant advancements in ATM information systems, several challenges have emerged that hinder the full realization of their potential. These challenges include the need for repeated data updates among different systems, the manual supplementation of business processes, and the excessive screen attention required from controllers.

1.2 China has made some progress in researching and implementing data exchange methods among different ATM information systems. These efforts have resulted in effective data synchronization between the ATMAS, A-SMGCS, and ATFM. This paper details the implementation and application of these data exchange methods, using the Beijing site as an example.

2. DISCUSSION

2.1 Data exchange

2.1.1. Information Systems

In the Beijing site, ATMAS, A-SMGCS(both Beijing and Daxing Airports), ATFM have put in to operation. The information systems provide functions as follows:

a) ATMAS serves Enroute control, Terminal control, Tianjin Approach control, and Towers based on properties of the controlled sector. It includes functions such as

surveillance data processing, flight data processing, safety net processing, etc.

b) A-SMGCS serves Towers and Airports, offering functions including surface situational display, alert, routing, and lighting guidance.

c) ATFM serves the Operations Management Center, providing functions such as flow control information management and departure flight sequencing.

Flight plans, Flight tracks, SSR codes, runway status, flow control information, Calculated Takeoff Time (CTOT), and other data are exchanged among above information systems according to predefined business processes. This ensures uniform display of the same data items across different controllers, reducing the need for manual verification and avoiding safety risks from information misunderstanding.

An overview of data exchange between information systems is shown in Figure 1.

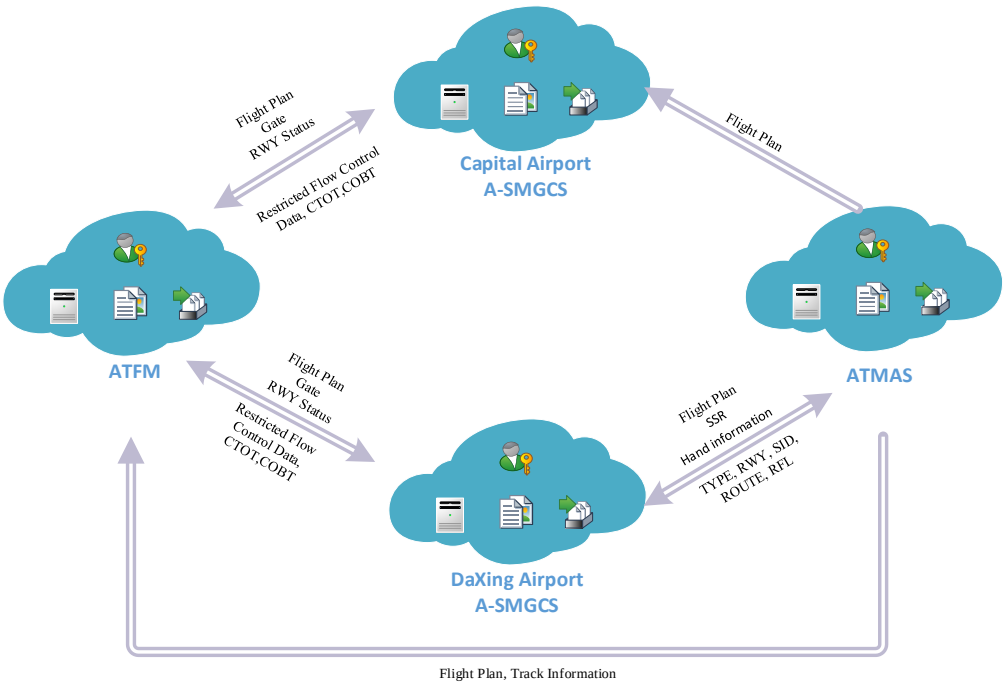

Figure 1. Overview of Data Exchange between Information Systems

2.1.2. Data exchange between ATMAS and A-SMGCS

Technical implementation：

In 2019, data exchange between ATMAS and A-SMGCS at DaXing Airport was put into operation, with the system connections as shown in Figure 2. There were dual TCP/IP redundant links between ATMAS and A-SMGCS.

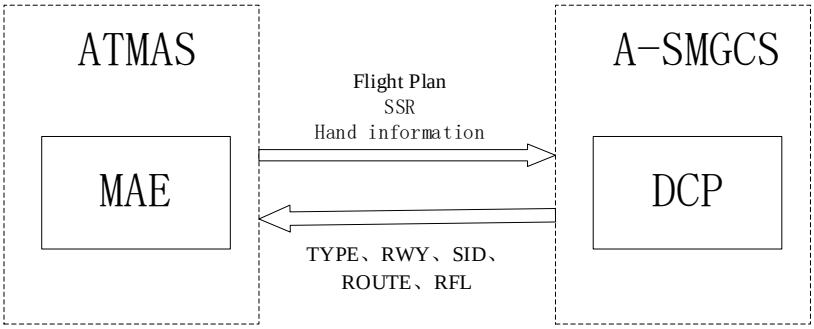

Figure 2. Connection between ATMAS and A-SMGCS

The client (A-SMGCS) subscribes data and request data update as needed from the server (ATMAS). ATMAS serves as the provider and validator of interface data, ensuring data consistency.

A-SMGCS can select specific data items for subscription according to business needs (e.g., RFL, CFL, DRWY, SID, STA) and conditions (e.g., the status of flight plans, departure/arrival airports, etc.). The data format utilizes a standard XML format, including information and command data.

Once the client subscribed data in ATMAS is updated, it is immediately published to the client (using the UPDATE-ITEM method). When the client needs to update data, it sends a request to the server (using the REQUEST method), and after approval, the server updates and publishes the data.

Functions：

Two-way Trigger Events: When controllers make changes to flight plans in A-SMGCS, it initiates data synchronization events in ATMAS, such as modifications of flight plans, SSR allocations, and handovers. Similarly, when controllers manage departing flights in ATMAS, it can automatically trigger corresponding events in A-SMGCS.

Bidirectional Data Synchronization: A-SMGCS receives flight plan data from ATMAS and generates corresponding flight plans. Based on predefined data modification permissions, adjustments can be made within A-SMGCS, such as aircraft type, wake turbulence, runway, SID, and cruising altitude. Simultaneously, STAR, routes, and other details can be modified within ATMAS. Data synchronization between the systems occurs automatically, ensuring that updates made in one system are reflected in the other.

Significance：

The data exchange ensures consistency in flight plan information between the two systems, minimizing the requirement for controllers to cross-reference flight plan details between them. This streamlines the flight plan handover process between the systems and reduces the workload for tower controllers and approach controllers.

2.1.3. Data exchange between ATMAS and ATFM

Technical implementation：

Since the deployment and application of ATFM in ATM of CAAC, data exchange with ATMAS has allowed for the real-time reception of system track and flight plan.

ATMAS efficiently transmits flight plan information utilizing UDP communication protocol in MH/T4029.3 formats, ensuring compatibility and smooth data exchange. Concurrently, system track is transmitted in Asterix Category 062 formats, providing detailed trajectory information necessary for effective traffic management operations.

Functions：

ATFM receives and processes system track from ATMAS and other surveillance data to form unified and optimized targets. This consolidated information is displayed on the situational interface.

Additionally, it utilizes flight plan information outputted by ATMAS to dynamically update flight SSR codes, runways, SID, STAR, and cruising altitudes.

Significance：

The trajectory information in ATFM is updated in real time along with ATMAS, improving the accuracy of flight traffic prediction in ATFM and assisting air traffic flow management personnel in intuitively understanding and monitoring the dynamics of flights within the airspace. Also, this function ensures lifecycle management of plans and provides data support for formulating air traffic flow management measures and operational monitoring.

2.1.4. Data exchange between A-SMGCS and ATFM

Technical implementation：

Bidirectional data exchange was achieved between the A-SMGCS and ATFM. A-SMGCS processes and displays traffic data, enhancing the operational efficiency of air traffic control. The data exchange interface utilizes TCP/IP-based dual redundant links, as shown in Figure 3.

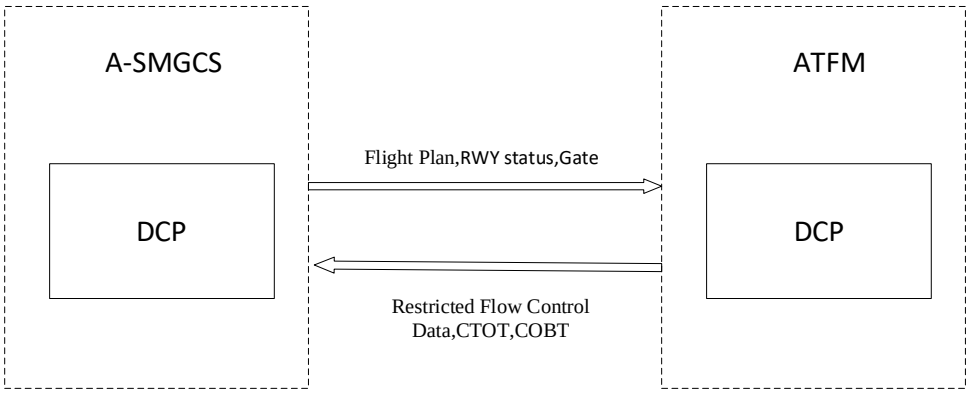

Figure 3. Schematic diagram of the TCP/IP link between A-SMGCS and ATFM

ATFM sends data to A-SMGCS using a universal XML file format. The system sends all data at fixed times every day and incremental data at fixed intervals, ensuring timely data updates and reducing system load.

ATFM subscribes to data from A-SMGCS based on requirements. Whenever there is a change in data in A-SMGCS, it is transmitted in real time to ATFM.

Functions：

ATFM receives flight plan data, gate, and runway status data sent by A-SMGCS of the Capital and DaXing airports to continuously update the calculation of COBT and CTOT.

A-SMGCS receives flow control data, CTOT, COBT, and other data sent by ATFM. These are displayed on the Electronic Flight Progress Strip(EFS). According to the time requirements of the traffic system, departure clearance and flow control restrictions are implemented.

Significance：

A-SMGCS displays flow data such as COBT and CTOT, thereby avoiding the issue of tower controllers having to monitor too many screens. ATFM updates CTOT in real-time based on changes in flight plans and runway status data from A-SMGCS, enhancing the accuracy and real-time of the system calculations.

2.2 Example

Take a departing flight as an example to illustrate the process of data exchange.

a) Upon receiving the FPL message, ATMAS generates flight plan information and sends it to A-SMGCS and ATFM.
b) ATFM calculates the CTOT for the flight based on the FPL message and updates it according to real-time flight plan data from ATMAS. The updated CTOT is then sent to A-SMGCS for display and serves as the departure clearance basis.
c) Tower controllers modify aircraft information such as type, wake turbulence, runway, SID, and RFL in A-SMGCS based on actual operations. This information is automatically synchronized with ATMAS, and aircraft are cleared for departure based on the CTOT received from ATFM.
d) After the aircraft takes off, it triggers the transfer of flight plan information between A-SMGCS and ATMAS.

2.3 Summary and Outlook

The data exchange among ATMAS, A-SMGCS, and ATFM has effectively fulfilled the operational requirements for controllers and air traffic flow management personnel, thus lessening their workload. The application of data exchange has successfully harmonized data information across various systems, leading to real-time synchronization and data accuracy.

At the same time, there has been a gradual exploration of connections between ATM information systems and external systems of airports, such as data exchange between A-SMGCS and lighting systems, AMDB, and other systems, fostering close operational ties between the tower and the airport.

In the future, China will further research the data exchange between AMAN function in ATMAS and ATFM to enhance approach and surface coordination efficiency.

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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