International Civil Aviation Organization

Third Meeting of the Asia/Pacific Air Traffic Management Automation System Task Force (APAC ATMAS TF/3)

Video Tele-Conference, 8– 10 June 2022

Agenda Item 4: ATM Automation System Implementation by States

4.1 Integration with External Systems

CONCEPT AND BENEFITS OF THE SECURE DATA BRIDGE

(Presented by Singapore)

SUMMARY

This paper showcases Singapore's development of a prototype Secure Data Bridge (SDB) to extract historical and real-time data from the Air Traffic Management System (ATMS) that would be useful for ATM related functions and services. The paper also shares the concept of the SDB and the benefits of testing potential use cases safely outside of the ATMS.

1. INTRODUCTION

1.1 The Air Traffic Management System (ATMS) contains valuable historical and real-time operational data and information such as surveillance, flight plan, meteorological, data link messages, safety alerts as well as historical ATCO actions. These data when extracted, curated, and stored in a data lake could be used for the research and development of other useful ATM related functions and services, such as the ATM Twin (similar in concept to a digital twin[1]), Digital Assistant/ATCO, predictive engines and big data analytics.

1.2 To fully maximise the benefits of operational ATMS data, Singapore has developed a Secure Data Bridge (SDB) prototype to extract data from the ATMS. The SDB is key to enable the implementation of the equivalent of a Digital Twin in the ATM domain.

1.3 The development of the SDB prototype was done under the auspices of the Aviation Innovation Research Lab (AIRLab), established in 2019 through collaboration between the Civil Aviation Authority of Singapore (CAAS) and the industry. One of the objectives of AIRLab is to innovate in the Air Traffic Management (ATM) domain through the use of open and advanced technologies. AIRLab undertakes the advancement of Open ATMS concepts through the development, deployment and demonstration of Proof-of-Concepts that would be key enablers to support and improve ATM efficiency, innovation and resiliency.

2. CONCEPT OF SECURE DATA BRIDGE

[1] A digital twin is a virtual model designed to accurately reflect a physical object.

2.1 The main objective of the SDB prototype was to design and build a proof-of-concept for passively tapping and streaming live operational data from the ATMS in an automated, safe and secure manner. Integration of the SDB with the ATMS needs to be transparent to operational users, without affecting ATC operational capabilities/performance, nor introducing additional safety concerns to users. This was done by ensuring that there would not be any consumption of dedicated resources from the safety critical system, or exposure of the secure zone of the operational ATMS to any additional security vulnerabilities.

2.2 The SDB prototype is connected to the ATMS via public Application Program Interfaces (APIs). Safe and secure extraction of live data from the ATMS was achieved using data diodes which provide a unidirectional secure gateway for the streaming of data. The SDB is capable of then translating the ATMS data streams into datasets to be used for different use-cases. The extracted data can also be filtered into two categories, i) privileged dataset and ii) sanitised public dataset. This ensures that sensitive data would not be shared with unauthorised personnel or entities.

3. BENEFITS AND POTENTIAL USE-CASES

3.1 Existing methods to extract historical ATMS data via manual means has been an extremely tedious and time-consuming task, while alternative methods to generated simulated data for testing purposes may not be able to reproduce the exact scenario that is experienced on the live operational ATMS. With the implementation of the SDB, automated extraction of data is not only limited to historical, but also real time operational ATMS data. The latter would be used in the ATM Twin and other Open ATMS collaborations without modifying or impacting the existing ATMS. Real time monitoring and comparison of the prototype behaviour would also be possible since both the live ATMS and ATM twin will be running concurrently.

3.2 Another potential use-case of the SDB would be the use of extracted data to train Artificial Intelligence (AI)/ Machine Learning (ML) models in the Digital ATCO prototype. Such prototype has the potential to provide assistive decision support tools to reduce controller workload. The extraction of ATMS data through the SDB allows for an accessible data source for future information-centric systems from which data analytics can be performed to identify underlying issues and improve ATC processes.

4. CONCLUSION

4.1 The SDB has been successfully developed and validated, with an operational impact assessment indicating no performance, throughput, or stability issues on integration with the ATMS. This will permit early experimentation in the ATM Twin safely, using actual data that is collected from the current ATMS.

5. ACTION BY THE MEETING

The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matter as appropriate.
