International Civil Aviation Organization

First Meeting of the Surveillance Study Group (SURSG/1)

(Video Teleconference, 20– 22 April 2021)

Agenda Item 4: Issues in surveillance data sharing

MESSAGE QUEUE SYSTEM SUPPORTING LOW-LATENCY SURVEILLANCE DATA DISTRIBUTION

(Presented by Hong Kong, China)

SUMMARY

This paper presents the tests conducted so far in Hong Kong, China in the distribution of real-time ADS-B data to support prototyping of future meteorological applications for operation in the System Wide Information Management (SWIM) environment.

1. INTRODUCTION

1.1 Surveillance data collected over an airspace could involve a large amount of data with high update rate. Availability of such surveillance data in low latency would be essential for operational use. This paper shares the experience of Hong Kong Observatory (HKO) in distributing real-time surveillance data to various consumer systems with low latency.

2. DISCUSSION

2.1 HKO is the designated meteorological authority in Hong Kong, China to provide weather facilities and services for international air navigation. In 2016, HKO acquired and installed an ADS-B Ground Station to collect real-time ADS-B data. HKO has developed situational displays which overlay real-time ADS-B aircraft positions, planned flight routes and meteorological data (Figure 1) giving aviation weather forecasters a visual indication of possible impact of significant convective weather to air traffic to better support their services to air traffic control, airlines and other stakeholders of the aviation community.

2.2 ASTERIX CAT21 data collected from the ADS-B Ground Station is inserted into a database before being retrieved by downstream consumers through regular polling. This creates significant loading to the database for consumers demanding second-by-second updates and is unable to scale up effectively too. There are other legacy approaches to handle the ADS-B data stream but they are proprietary and are confined to specific applications.

2.3 Recently HKO studied the implementation of data streaming using message queue (MQ) to enhance the efficiency and reliability of distributing ADS-B data to consumer systems. Among all the available MQ implementations, Apache Kafka[1] was chosen for the study because of it light weight and

[1] See https://kafka.apache.org/

low latency design, open-sourced licensing and large community support. Figure 2 illustrates the path of distributing real-time ASTERIX CAT21 ADS-B messages in the test system developed by HKO. A producer after receiving an ADS-B message from the Ground Station will add the message to a Kafka topic, and those consumers who have subscribed to the topic will get a copy of the ADS-B message immediately. In addition to Kafka consumers, messages can be further distributed through the WebSocket protocol[2] to capable browsers and applications. Initial tests indicated that the performance of sharing live ADS-B data with the test system is very promising: While there is a continuous data stream of about 2-3 megabits per second passing to each consumer, the average latency[3] of individual message is only about 30 milliseconds under normal system load and network activities.

2.4 Although the intention of distributing real-time ADS-B data is for prototyping future meteorological applications which fuses different kinds of information for provision in the future SWIM environment, the HKO has successfully demonstrated the feasibility of distributing data streams with low latency with existing technologies. Further studies will be made to understand the behavior of the implementation under different input traffic, system load, consumer number and network conditions.

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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[2] The WebSocket protocol is standardized by the Internet Engineering Task Force (IETF) as RFC6455. See https://tools.ietf.org/html/rfc6455 for details

[3] The difference in time between a message received by an consumer and inserted into a Kafka topic

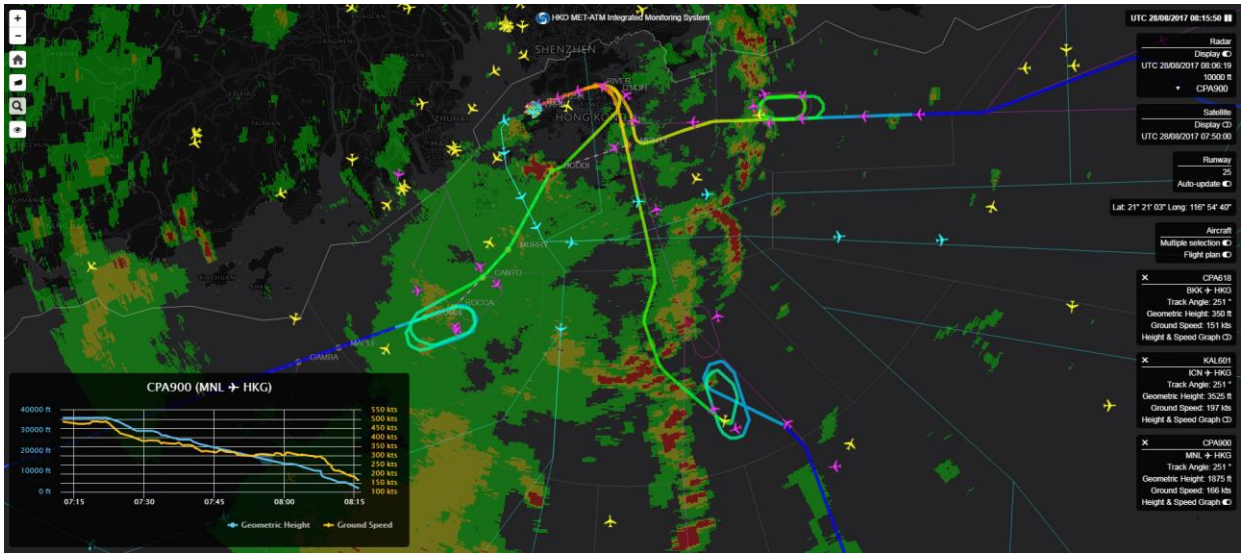

Figure 1: HKO Integrated Display showing ADS-B real-time aircraft positions together with weather radar imageries.

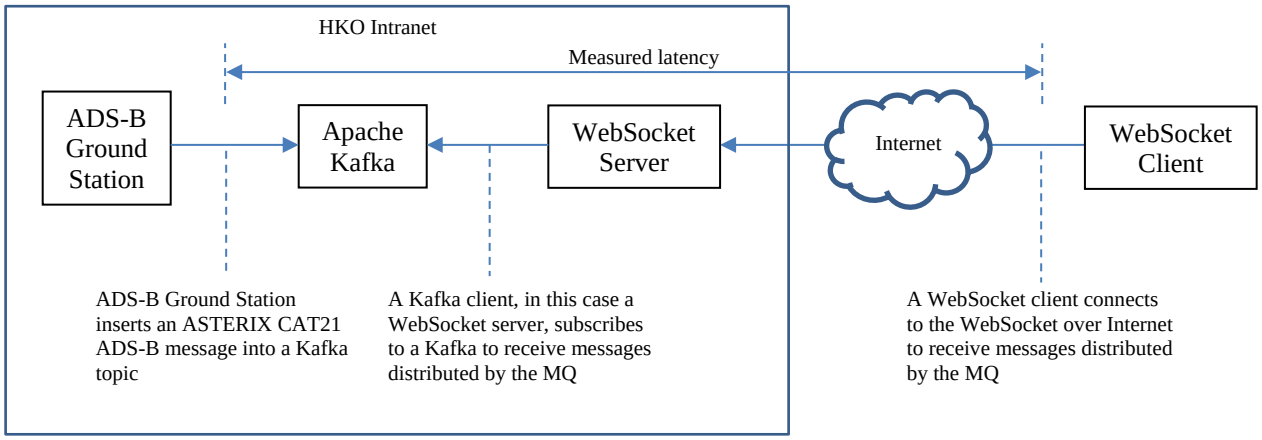

Figure 2: Schematic diagram showing distribution of ADS-B messages in the test system developed by HKO