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

CONSIDERATIONS IN DESIGN OF INTEGRATED ARRIVAL AND DEPARTURE MANAGER FOR HONG KONG INTERNATIONAL AIRPORT

(Presented by Hong Kong China)

SUMMARY

This paper presents the design considerations of an Integrated Arrival and Departure Manager (IAD) for the Hong Kong International Airport. It highlights the enhanced features of the IAD and its integration with the air traffic management system to enhance efficiency and streamline decision-making processes for air traffic controllers in handling complex arrival and departure air traffic.

1. INTRODUCTION

1.1 With increased complexity of arrival and departure traffic at the Hong Kong International Airport (HKIA) under the Three Runway System (3RS) operation, seamless coordination between arrival and departure traffic flow is crucial to ensuring maximum capacity at the HKIA is delivered in an efficient manner. An Integrated Arrival and Departure Manager (IAD) with enhanced features is being implemented at the HKIA to provide comprehensive advisories to air traffic controllers for their safe and efficient management of the arrival and departure traffic in an integrated manner.

2. DISCUSSION

(A) Mixed-mode Runway Capacity Management & Traffic Off-loading

2.1 Under the 3RS operation at the HKIA, an "A-D-M Mode" will be adopted. This mode will be utilized under normal circumstances, wherein one runway to be used for **A**rrivals, another runway for **D**epartures, and the remaining runway for **M**ixed-mode operations.

2.2 Under the "A-D-M Mode," two runways will be designated for arrival flights, with runway selection for arrivals based on two key factors: (i) parking stand allocation and (ii) aircraft navigational capabilities. Similarly, two runways will be available for departure flights, with runway assignment based on Standard Instrument Departures (SIDs).

2.3 The runway assignment logic outlined above could result in circumstances where excessive arrivals or departures on the mixed-mode runway lead to undue delays for the opposite type

of traffic. It is crucial to carefully manage and balance the allocation of arrivals and departures on the mixed-mode runway to ensure efficient operations and minimize potential delays.

2.4 To address the circumstances, the IAD is designed to incorporate a feature allowing users to input the maximum number of arrivals and departures per hour for the mixed-mode runway. This function enables the system to offload some arrivals and departures to other available runways. Figure 1 illustrates a conceptual design of the Human-Machine Interface (HMI) for this feature.

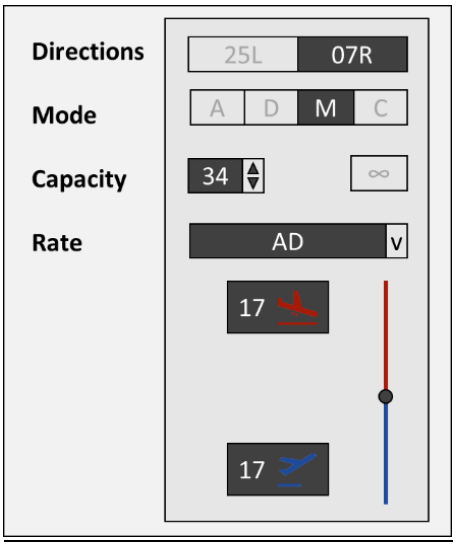

Figure 1 - HMI for user to input maximum number of arrivals and departures per hour

2.5 By specifying the maximum hourly capacity and arrival-departure mix for the mixed-mode runway, the IAD will then be able to calculate and recommend an appropriate total number of arrivals and departures per hour. Once the user has accepted the recommendation, the IAD can allocate arrivals and departures to the mixed-mode runway without overloading it. Any surplus of arrivals and departures will be proactively allocated to other available runways, ensuring balanced traffic distribution and avoiding congestion. This dynamic allocation mechanism optimizes operational efficiency and minimizes delays.

(B) Red Lightning Warning at HKIA

2.6 Thunderstorms, particularly during the wet summer season or the passage of typhoons, are not infrequent at the HKIA, posing safety hazard to ground staff due to lightning strikes. To mitigate this risk, a Lightning Warning System has been installed at the HKIA to alert ground staff of such imminent danger. When the Red Lightning Warning is in force, all ground operations have to be suspended, and aircraft affected by the warning must adjust their Target Start Up Approval Time (TSAT) and Target Take-Off Time (TTOT) as adherence becomes impossible.

2.7 The IAD is designed to allow users to activate the Red Lightning Warning through a dedicated HMI. Once the Red Lightning Warning information is input into IAD, the system can re-sequence affected aircraft after the warning ends and update their TSAT and TTOT accordingly. Figure 2 depicts the HMI for this functionality.

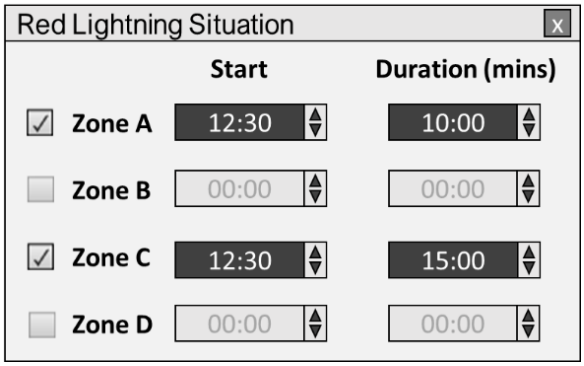

Figure 2 - HMI for Red Lightning Warning Input

(C) Weather Mode & Weather Deviation Factor

2.8 Thunderstorms also affect arriving aircraft in the air. Part of the airspace / arrival routes might be blocked by weather and become not desirable for aircraft to use. Arriving aircraft might thus deviate from the published routes and fly alternative routes, resulting in discrepancies from the pre-defined Estimated Time Over (ETO) calculated by IAD.

2.9 To maintain a stable arrival sequence, IAD has the provision of a Weather Mode. Under this Mode, trajectory updates for aircraft within the Weather Area will be suspended. By doing so, the arrival sequence will not be upset by sudden changes in aircraft track for those aircraft under weather deviation, since no trajectory re-calculation will be triggered.

2.10 In addition, Weather Deviation Factors (WDF) can be input to compensate for the discrepancies from the pre-defined ETO. A negative value for WDF indicates the situation that short-cuts are taken by aircraft on that particular route, while a positive value for WDF indicates that detours are taken by aircraft on that particular route resulting in extra track-miles being flown. Figure 3 shows the HMI of this feature.

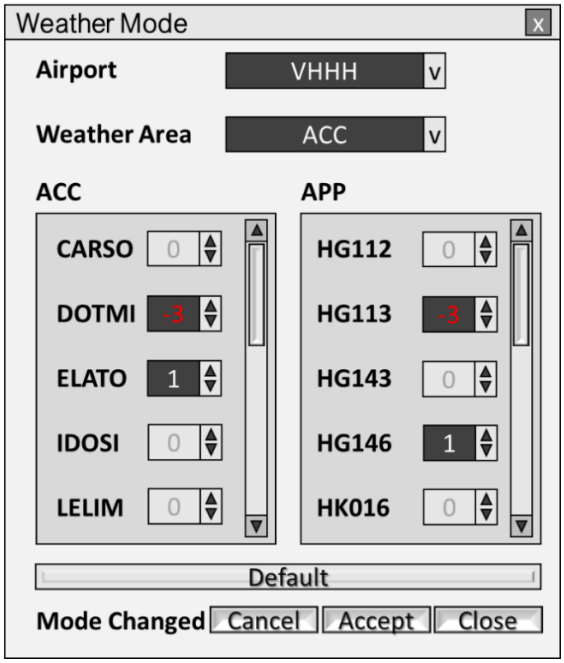

Figure 3 - HMI for Weather Mode & Weather Deviation Factors

(D) Integration with Air Traffic Management System

2.11 In order to streamline operations and enhance operational efficiency, the IAD window will be seamlessly integrated within the Air Traffic Management System (ATMS), eliminating the need for air traffic controllers to switch to a separate IAD display screen.

2.12 The integration of IAD with ATMS will facilitate the display of IAD advisory data within the ATMS environment. Essential information, such as the subsequent fix with AMAN Required Time Over (RTO) at the gate fix, Time to Lose (TTL) or Time to Gain (TTG), and hold advisories, will be available for display in track labels and flight lists within the ATMS. Synchronization of information such as runways and routes mechanism will also be established between the IAD and ATMS to ensure accurate and up-to-date information between the two systems. If discrepancies arise between the advisories from IAD and ATMS, the responsible controller can be promptly notified, promoting clear visibility and awareness of any variations. Figure 4 illustrates an example of the track label of ATMS showing the advisories from IAD.

Figure 4 - Track Labels of ATMS with IAD Advisories

2.13 This comprehensive integration significantly enhances situational awareness, streamlines decision-making processes, and provides air traffic controllers with a unified HMI that consolidates available information and tools.

(E) Integration with Approach Spacing Tool

2.14 Apart from integration with ATMS, IAD will also be integrated with the Approach Spacing Tool (AST) ensuring maximum capacity at the HKIA is delivered in a safe and efficient manner.

2.15 Along with providing the arrival sequence to the AST for determining the initial sequence of arrival flights, the IAD is designed to transmit information regarding flow constraints to AST. This facilitates various scenarios, such as departures slots for mixed-mode runways or accommodating special circumstances like a VIP flight requiring additional spacing from other arriving aircraft. The flow constraints are presented as relative gaps from lead aircraft and serve as additional parameters for AST to calculate spacing for arrival pairs.

2.16 Furthermore, the IAD will also provide AST with information regarding constraints on runway availability that mandate flights to land after a specified time. These constraints may arise due to factors such as runway closures or reservation slots. AST, in response, can generate an indicator based on the information such as the Scheduled Time of Arrival (STA) for the first aircraft allocated to a runway. The indicator serves as information for the controller, highlighting the requirement for the flight to land after the specified time to ensure compliance with the runway closure or reservation slot.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the considerations in the design and implementation of an Integrated Arrival and Departure Manager for the Hong Kong International Airport;

b) consider to incorporate the relevant design considerations of an Integrated Arrival and Departure Manager into the ATMAS IGD; and

c) discuss any relevant matter as appropriate.

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