International Civil Aviation Organization

The Second Meeting of the Asia/Pacific Air Traffic Management Automation System Task Force (APAC ATMAS TF/2)

Video Tele-Conference, 14 – 16 September 2021

Agenda Item 4: ATM Automation Systems Implementation by States

4.4 Integration and Interoperability with External Systems

BENEFITS OF AN INTEGRATED ARRIVAL AND DEPARTURE MANAGER

(Presented by Singapore)

SUMMARY

This paper presents Singapore's implementation of an Arrival Manager (AMAN) integrating with the Departure Manager (DMAN). The paper highlights the benefits of an Integrated AMAN DMAN (IAD) where both arrival and departure information are shared across the Approach and Tower Controllers through an automated environment, enhancing collaborative decision making.

1. INTRODUCTION

1.1 Efficient air traffic movements in and out of the airport rely on close collaboration and coordination with stakeholders. An IAD system is where both AMAN and DMAN are integrated to enhance the decision-making process for air traffic controllers to improve air traffic management.

1.2 With IAD, controllers will have an even more accurate predictability of flights. The various ATS units will be able to rely on a same situational display for traffic planning which leads to reduce holding on the ground. This also creates possibility to reduce delays for arrival if the departure runway is predicted to be available for landing. Overall, this would contribute to reduction of fuel burn for airlines.

2. AMAN

2.1 AMAN is a decision support system/tool used to provide automated sequencing solutions for the controllers to manage arrivals at an airport. The optimized arrival sequence is achieved by factoring in the defined landing rate/flow constraint, the required spacing for flights, and many other factors.

2.2 Singapore had integrated the AMAN with the Air Traffic Management System (ATMS) in 2013. With AMAN, Approach controllers have a common arrival sequence; controllers will know when to hold or set course the aircraft for arrival and approach in their areas of responsibility. However, without integration with DMAN, there are limitations to the usage of AMAN. The display of departure sequence on AMAN was not updated based on the traffic situation, hence, the Approach controllers have little situational awareness on the departure demand. Other information such as runway closure was set on individual system and not shared across the different ATS units.

3. DMAN

3.1 DMAN is a planning tool which aims to improve the departure sequencing/flows at airports. It optimises the target times for flights at the runway and at their stands. DMAN ensures that the runway capacity is maximised while reducing congestions on both taxiways and runway holding points.

3.2 Prior to DMAN, controllers have been using the Pre-Departure Sequencer (PDS) system, which was part of Changi Airport Group (CAG)'s Airport Collaborative Decision Making (A-CDM) system. Introduced in 2016, the A-CDM structure includes a new set of planning times such as Target Off Block Time (TOBT) and Target Start-up Approval Time (TSAT) that are essential to manage the pre-departure processes[1]. However, the PDS was not integrated with AMAN and therefore, was unable to take into consideration the arrival traffic when planning for the departure sequence. The implementation of DMAN integrated with AMAN system would contribute to the optimization of mixed-mode runway operations as the automated sequencing solutioning will be able to take into consideration both arrival and departure flight information.

3.3 The core function of DMAN is to optimise the departure sequence at the airport based on the readiness of the aircraft. This moved from first-come, first-serve mode of operation to best-planned, best-served operations. The system sequencing of departure would allow efficient management of traffic, providing controllers, ground handlers, airlines, and pilots a common awareness of the different target times. If congestion occurs in the airport, all parties would be aware of the expected delay and can manage their resources accordingly. Aerodrome controllers can use the system to meter the traffic within the airport.

3.4 Another function of DMAN is the Minimum Departure Interval (MDI), which allows controllers to input a time interval between two successive departures on a similar Standard Instrument Departure procedure (SID) or SID group or to a specific destination. This feature would allow Aerodrome controllers to better regulate traffic in situations when Air Traffic Flow Management - Ground Delay Program (GDP) has been imposed or where departure routes in the air are affected by inclement weather. With DMAN and the MDI function, the controllers need not conduct manual calculations for these affected aircraft, the system will update the TSAT and all concerned parties will be informed of the delay duration. This significantly reduces the workload of controllers.

3.5 Other features of DMAN includes: display of Arrivals, Strategy Window, KPI, What-if, Traffic Load Charts, Improved Handling of Actual Times, Improved Handling of CTOT Constraints, Handling of ASMGCS Data via SMAN, Ship Crossing and Fusion Window.

4. INTEGRATED AMAN DMAN

4.1 In June 2021, Singapore successfully implemented IAD when DMAN system was integrated with AMAN. The integration is the first of its kind to operationalize and enhances productivity, sequence efficiency, and the ability to predict future traffic load. The integration eliminated the need for controllers to manually insert a placeholder for arrival flight in DMAN on the departure runway, which had previously created possible delays for departures due to the arrival and to churn out a new TSAT if necessary. With IAD, the process of information sharing is automated. This aids in the controllers' decision-making process, especially for mixed-mode runways.

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[1] More information on A-CDM structure can be found in ATMAS TF/1 Agenda Item 5.3, IP/16

4.2 Previously, when AMAN and PDS were not linked, the coordination for landing rate/flow constraint was carried out manually. It was challenging for controllers to manage traffic during abnormal and contingencies situations such as unavailability of runway(s) due to FOD, etc. Controllers did not have a common picture and more coordination have to be made. With IAD, controllers are able to configure the flow constraint patterns of arrivals and departures, the system calculates the respective delay for all flights to fit into this pattern, painting it on the timeline for all to see. This reduces the workload of Aerodrome controllers and allow Approach controllers to know when to provide the necessary departure spacing, overall enhancing traffic flow regulation.

4.3 The IAD HMI display of departure strips on the Runway timeline has changed from displaying Estimated Time of Departure (ETD) to a departure sequence calculated by DMAN. This departure sequence is based on the real-time Target Take Off Time (TTOT), making the departure timeline more accurate, thus allowing both Aerodrome and Approach controllers to better use this information for planning purposes. IAD also allows more information to be displayed (when required) on the timelines; Callsign, Aircraft type, Wake Turbulence Category, SIDs, Delays, Target Start-up Approval Time (TSAT), Target Off Block Time (TOBT), Calculated Take-off Time (CTOT) and Flight State. These fields can be hidden or shown base on how important or relevant the information is to their Area of Responsibility (AOR) for display. Finally, the arrival flight sequenced will accord delay to the departure flight as according if the TTOT conflicts with an arrival flight.

4.4 As IAD require information from 2 different sources, Airport Operations Control System (AOCS) and ATMS to achieve its capabilities, fusion window was introduced to fuse these 2 sources together to produce a singular combined flight plan data. For example, AOCS do not contain SIDs and ATMS produces that in order for MDI function to work.

4.5 Operationally, the IAD system is identified as one of the enablers which will help to maximise runway throughput. Environmentally, DMAN help airlines to optimise taxi-out duration, leading to saving in fuel, which will reduce carbon footprint.

4.6 For Aerodrome control operations, most controllers can now refer to the AMAN display. The need for a dedicated display for DMAN is not required, this reduces the number of screens. With both arrival and departure on the same display timeline, it enhances situational awareness and reduced controllers' workload with automatic accounting for arrival information in departure sequencing.

5. FUTURE INTEGRATION

5.1 Singapore plans to further enhance the IAD to integrate with the Surface Manager (SMAN). Currently, the TTOT calculation uses a fixed table of time in DMAN for the taxi duration, which may not be accurate due to traffic or other reasons. The SMAN would allow the taxi time to be precise by using ground sensors to determine the speed and the taxi distance based on the route instructions that the controllers issued to aircraft. This would allow real-time adjustment to the taxi duration, which in turn a real-time update to the TTOT.

5.2 The timing at runway provided by SMAN, which takes into consideration this dynamic taxi time, would also be updated on DMAN to provide an accurate real-time traffic sequence, and hence improve situational awareness of the controllers in the Aerodrome and Approach ATS Units.

6. ACTION BY THE MEETING

6.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matters as appropriate.

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