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Eleventh Meeting of the Asia/Pacific Air Traffic Flow Management Steering Group (ATFM/SG/11)

Video Teleconference, 02 – 06 August 2021

Agenda Item 4: Review of Current CDM/ATFM Operations and Problem Areas

DEVELOPMENTS IN THE LONG-RANGE ATFM INITIATIVE IN SINGAPORE

(Presented by Singapore)

SUMMARY

This paper shares Singapore's effort to develop Long-Range Air Traffic Flow Management (LR-ATFM) initiative as part of the long-term plans in Network Operations (NOPS) thread within the Aviation System Block Upgrades (ASBU).

1. INTRODUCTION

1.1 The ICAO Global Air Navigation Plan (GANP) along with the Aviation System Block Upgrades (ASBU) methodology provides guidance for operational improvement to increase efficiency and enhance predictability. Within the ASBU framework is the Module thread for Network Operations (NOPS), which aims to guide the development of air traffic flow management (ATFM) operation towards the envisaged end goal of shifting ATFM from trajectory management to airspace constraints management enabled by timely and precise information. This end goal could be realized when Air Navigation Service Providers (ANSPs) are able to manage airspace constraints real-time and adapt capacity to accommodate demand, an evolution from the current modality where we manage demand to suit available capacity. Airlines will then need to plan and execute their own business and mission trajectories.

1.2 NOPS Block 1 aims to introduce enhanced processes to manage flows and improve overall fluidity. In this Block, one of the main features of ATFM includes the development of "management of arrival/overfly times Targeted time of arrival (TTA)/ Targeted time over (TTOs)". With TTA/TTOs, it is envisaged that the intended ATFM measures would be more encompassing, increasing dynamism of flow management, while ensuring equity in delay management. This enhanced ability must be complimented by continuous developments on the reliable and precise information sharing, and exchange mechanism, which eventually will also form the foundation for implementation of System Wide Information Management (SWIM) and Flight and Flow in Collaborative Environment (FF-ICE).

2. DISCUSSION

Background

2.1 At the 8th meeting of the ICAO APAC ATFM Steering Group in 2018, New Zealand and Singapore jointly presented a paper on – *Long Range ATFM Concept trials* which detailed the initial concept of operations (CONOPS) for disseminating ATFM delay to flights that are already en-route but several hours away from entering the area of responsibility of the Air Navigation Service Provider (ANSP).

2.2 Singapore also studied other initiatives which can help to regulate flow of air traffic to minimise holding and vectoring. For instance, in Switzerland, a collaboration between Swiss Air and Sky Guide, called the iStream aims to optimize peak-time airport arrivals by assigning “target times” for each flight’s arrival where approach sequences can be established in advance. This ensures efficient approaches and reducing the need to fly holding patterns or excessive vectoring for delay. Through iStream, Swiss Air manages and coordinates the intended arrival time of their company flights arriving at Zurich Airport between 0600 and 0700 (local Switzerland time) to optimize their approaches.

2.3 Singapore saw similarity on the intent, potential of the model of operations and proceeded to further investigate the feasibility to conduct trials in Singapore. Through a collaborative effort with Singapore Airlines (SIA), an operational trial plan along with information exchange requirement, coordination processes and initial business rules was developed to serve the need for Long-Range ATFM (LR-ATFM) capabilities.

Objectives of the LR-ATFM Trials

2.4 One of the objectives of the LR-ATFM is to develop the ability to capture more flights during an ATFM measures that is applicable at all phases of flight. For ground-delay program (GDP), there is a fine balance between longer lead-time for predictability to stakeholders and shorter lead-time for better resolution on demand prediction and capacity reducing elements. This trade-off affects the number of flights that would be participating in the ATFM measure. Traditionally, long haul flights have been exempted from ATFM measures mainly due to the inability to attain precise enough trajectory information on them at a time horizon sufficiently early for it to be used in the ATFM modelling and regulation. Additionally, an effective means to communicate and negotiation on the ATFM restriction with long haul flights is also lacking.

2.5 The envisaged CONOPS would encompass issuing CTOTs in a conventional GDP as well as, issuing TTOs to long-haul or flights that are already en-route for time-based metering. The merging of the 2 ATFM method is still a work in progress to balance between predictability for air traffic management planning and airlines operational efficiency.

2.6 Another objective for this trial is to formulate the information exchange processes which would take place in the SWIM and FF-ICE environment. By doing so, it can help to contribute to the development of the use cases and systems architecture when implementing FF-ICE.

2.7 The LR-ATFM trials in the future could also provide the opportunity to experiment with inter-airline ATFM slot negotiation as airlines would have the best knowledge of their business model and operating cost index. This translate to their readiness to reduce speed mid-flight to comply with an ATFM restriction characteristic of the LR-ATFM mode of operation. If the flight composition on long-range and short-range during the time of the ATFM measure is favorable and with ATM considerations factored in, it might be advantageous with the establishment of agreed business rules for the airlines to self-manage the TTOs issued, catering to their operational needs.

Phases of the LR-ATFM Trials

2.8 Since November 2019, Singapore had initiated LR-ATFM trials with SIA with the aim to regulate the flow of arrivals through issuance of TTOs. The trials were planned to be conducted in 3 Phases with the first phase as an initial proof-of-concept and subsequently the phased approach to advance the information exchange processes and operationalization of the concept of operation (refer to Figure 1).

	Phase 1 Completed October 2019	Phase 2 Completed March 2020	Phase 3 (Current) From April 2020
Objectives	Proof-of-concept	<ul style="list-style-type: none"> Development on information exchange processes Methodology on calculation of TTOs to develop an algorithm for Phase 3 progression 	<ul style="list-style-type: none"> Web-portal development and refinement Expand participation to other airlines

Figure 1: Three phases of the LR-ATFM trials in Singapore

2.9 Singapore is currently in the third phase of the trials to further refine work flow processes, encourage participation from other airlines and make improvements to the functionalities and human machine interface in the web-portal which we developed as an interim information exchange platform for the purpose of this trial. The following Figure 2 shows the interface of the developed web-portal for LR-ATFM and the inputs required from airlines.

The screenshot shows the CAAS web-portal interface. It includes a search bar with fields for 'Callsign', 'ETO', and 'Fix Name'. Below the search bar is a table with columns: 'Callsign', 'Fix Name', 'ETO', 'ELDT', 'TLDT', 'STA', 'Delay', and 'Intent'. To the right of the table is a vertical timeline showing flight slots from 21:00 to 21:27. Annotations with arrows point to specific parts of the interface: 'Inputs required by Airlines OCC' points to the search bar; 'Swap between flights possible based on slots available' points to the timeline; and 'Information for the airlines calculated by the web-portal algorithm' points to the 'Delay' and 'Intent' columns of the table.

Figure 2: Screenshot from Singapore's LR-ATFM web-portal showing the main features as well as the inputs required from airlines

Information exchange mechanism

2.10 Operations on the LR-ATFM trial starts with airlines uploading flights details and the best-known Estimated Time Over (ETO) over a corresponding metering points into the system. The system will progress the flight’s Estimated Landing Time (ELDT) by forward calculation through a combination of a static Estimated Elapse Time (EET) from metering point to landing, and the input ETO for calculation of an Estimated Landing Time (ELDT). (i.e. $ELDT = ETO + EET$).

2.11 Based on the ELDTs, a system generated Targeted Landing Times (TLDTs) will ensure a pre-defined separation interval between each arrival flight. With these TLDTs, the system will further process a Target Time Over (TTO) the concerned metering point for the regulation of traffic flow. The diagram below in Figure 3 shows the information flow processes.

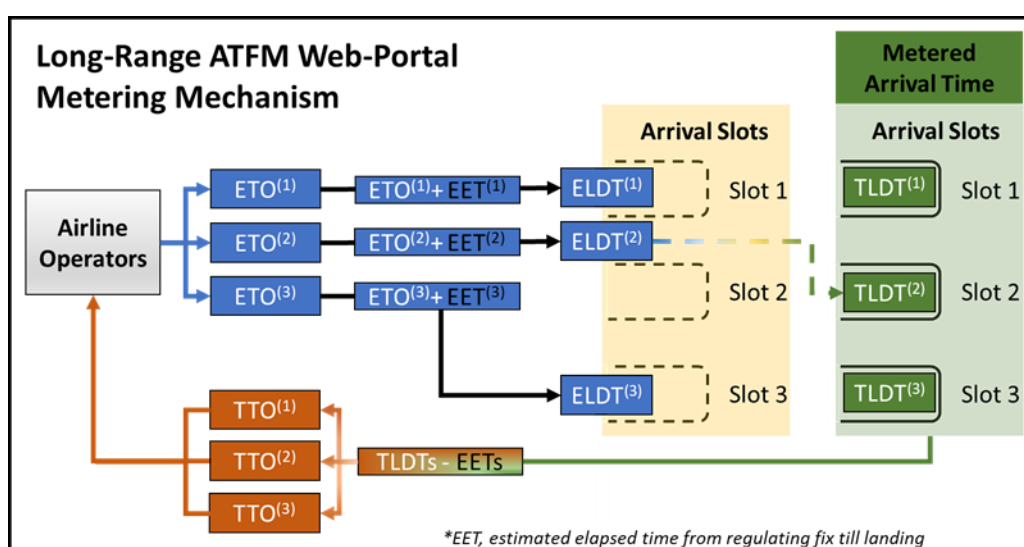


Figure 3: Information flow and processes chart for inputs into the long-range ATFM web-portal

2.12 The LR-ATFM trials are conducted daily (between 0500-0700 local Singapore time) which has been identified to be the period in which majority of arrivals were long haul flights. In order to provide some form of predictability for operational planning, initial assessment was to set a ‘cut-off’ timing to which the airlines are able to input/update on their ETOs. Another consideration for the need to have an early “cut-off” timing is the limitation on the amount of delay which an aircraft can absorb per hour en-route. Currently, the ‘cut-off’ timing is set at 4 hours before their latest updated ETOs.

Lesson Learnt

2.13 Accuracy of ETO inputs by airlines has been identified as one of the key factors for successful LR-ATFM measures, as the compliance window for TTOs has to be small and precise, as compared to CTOTs used in GDPs. Inaccurate ETOs will lead to unmeaningful TTOs being calculated and pilots will not be able to comply to such timings, even if aircraft is flying on its nominal flight trajectory.

2.14 Upstream en-route weather deviation and track shortening opportunities will have an impact on the flight trajectory and compliance with the TTO window. While weather deviation cannot be avoided, pilots need to be cognizant that by accepting or requesting for track shortening en-route, the compliance to the issued TTO might be affected if the revised trajectory is not compensated with speed adjustments. For LR-ATFM measures (or Trajectory Based Operations in future) to be effective, we foresee a need for the TTO compliance window to be less than +/- 1 minute.

Next Steps

2.15 The data collected thus far is small due to low volume of traffic. This limits the ability for detailed post operational analysis. As such, Singapore will continue the trials with the aim to garner more participation from other airlines and gather more data to aid in refining the developed process and procedures. The next step is to explore expanding the duration of operation for the LR-ATFM trials.

2.16 Singapore will also explore ways to improve the data exchange processes through possible automation ahead of SWIM and FF-ICE implementation, with a possible focus on the use of the electronic flight bag. This could possibly facilitate a more efficient process for the communication of the ATFM restriction to the flight crew directly.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) note the information contained in this paper

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