International Civil Aviation Organization

Fourteenth Meeting of the Asia/Pacific Air Traffic Flow Management Steering Group (ATFM/SG/14)

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

AIR TRAFFIC FLOW MANAGEMENT IN THE UNITED STATES OF AMERICA

(Presented by United States of America/Federal Aviation Administration)

SUMMARY

This working paper discusses Air Traffic Flow Management (ATFM) processes, personnel, tools and Collaborative Decision-Making (CDM) used by the Federal Aviation Administration in the US. The FAA is sharing this information in hopes that its experience will prove valuable to Air Navigation Service Providers in Asia-Pacific as they develop and improve cross-border ATFM together with their stakeholders. The paper also calls for expanding regional collaboration on cross-border ATFM in Asia-Pacific, and for establishing a process and a platform for integrated Operational Information System to support regional CDM on a daily basis.

1. INTRODUCTION

1.1 At the eleventh meeting of the Air Traffic Management Sub-Group in October 2023, the FAA presented an information paper[1] Air Traffic Management (ATM) System, automation platforms, Traffic Management Measures (TMMs), and Collaborative Decision-Making (CDM) processes used by the Federal Aviation Administration (FAA) in the US.

1.2 This working paper builds on previously provided information to emphasize the importance of continually updating and sharing information for effective and efficient flow management. The paper focuses on the layered Air Traffic Flow Management (ATFM) processes, personnel, tools used by the FAA and details cross-border flow management between Area Control Centers[2] (ACC) in the NAS.

1.3 The FAA hopes our colleagues in the Asia-Pacific region will find the information presented in these two papers useful in their efforts to develop and improve cross-border regional ATFM along with a regionally integrated information-sharing capability about available routing, operating conditions, and status of equipage in Asia-Pacific, along with active advisories, NOTAMs, and other important notifications.

[1] Eleventh Meeting of the Air Traffic Management Sub-Group (ATM/SG/11) of APANPIRG, IP/06 https://www.icao.int/APAC/Meetings/2023%20ATM%20SG%2011/IP06%20US%20Experience%20with%20Air%20Traffic%20Management.pdf

[2] In the US, ACC are known as the Air Route Traffic Control Centers (ARTCC).

2. DISCUSSION

2.1 As Air Navigation Service Provider (ANSP), the FAA's Air Traffic Organization (ATO) is responsible for safe, orderly, and expeditious flow of air traffic in the National Airspace System (NAS). ATO applies the minimum delay needed by using hierarchical approach to ATFM:

- At the national level, Air Traffic Control System Command Center (ATCSCC) monitors and manages capacity-to-demand imbalances over the entire NAS and coordinates cross-border air traffic flow issues and needs with neighboring Air Navigation Service Providers (ANPS). ATCSCC also maintains the FAA's Operational Information System (OIS) used for centralized information update and sharing with respect to NAS status, international status, severe weather development, Ops plans, national playbook, and current restrictions.

- At the regional level, Traffic Management Units (TMUs) in twenty-two ACCs monitor and balance traffic flows within their areas of responsibility and in accordance with active traffic management initiatives and programs in the NAS. TMUs ensure harmonized resolutions to both regional and national challenges in unison with ATCSCC and stakeholders.

- At the local level, TMUs in designated Terminal Radar Approach Control (TRACON) facilities ensure that local challenges are addressed in a harmonized manner along with other challenges in the NAS.

- At the aerodrome level, tower personnel work through the overlaying TRACON facilities, if available, or directly with the overlying ACC to address capacity-to-demand imbalances within their areas of responsibility and in a harmonized manner with other concurrent challenges in the NAS.

2.2 To maintain the integrity of the air traffic system, FAA requires facility traffic management personnel to prioritize use of time-based management (TBM) when evaluating traffic flow management options. TBM is a methodology for aircraft sequencing by assigning crossing times at specific points along an aircraft's trajectory. TBM applies time to mitigate demand-to-capacity imbalances while enhancing efficiency and predictability of the NAS. TBM techniques and tools are used only when needed, usually during periods when demand exceeds capacity. However, to sustain operational predictability, and regional or national strategic plan, these tools can also be used during periods when demand does not exceed capacity.

2.3 The FAA uses three key automation platforms to conduct TBM. Collectively referred to as the *3Ts*, they include Traffic Flow Management System (TFMS), Time Based Flow Management (TBFM), and Terminal Flight Data Manager (TFDM).

- Operating at the national level, TFMS supports management of capacity-to-demand imbalances across the entire NAS. TFMS creates demand predictions for airspace and airports, and provides common situational awareness of current and forecasted weather impacts, special use airspace and other constraints in the NAS. TFMS sets the stage for application of more granular ATFM functions that help manage air traffic flows through individual resources that may be constrained, and supports development of Traffic Management Measures (TMMs) that may be needed to pre-condition air traffic flows for TBM during periods with significant or long-lasting capacity-to-demand imbalances.

- Operating at the ACC level, TBFM is an Arrival Manager (AMAN) automation platform used for focused ATFM through individual NAS resources where merging of traffic flows occurs, including waypoints along the borders with adjacent ACCs. With its

scheduling[3] and metering[4] functions, TBFM helps manage air traffic flows by creating resource-specific time-based schedules and provides tools for reliable execution of time-based schedules. TBFM considers individual aircraft trajectories and performance, resource-specific spacing needs, and other factors and conditions in the NAS as needed for a focused ATFM through a specific constraint point[5].

- Operating at the airport level, TFDM is a Departure Manager (DMAN) automation platform for airport surface operations management and includes electronic flight strips. Automatic updates to controller displays with the latest flight data delivered through improved Electronic Flight Data (EFD) exchange and Electronic Flight Strips (EFS) will be delivered to twenty-two airports in the NAS, and full TFDM functionality that enables Airport CDM (A-CDM) and integrated data sharing and decision-support for holistic management of surface and airborne traffic flows at twenty-seven airports in the NAS. The FAA has started deploying TFDM functionalities in October 2022, and plans to complete installations at all of the forty-nine sites in 2029.

2.4 ATFM across ACCs borders is accomplished through collaboration between all CDM stakeholders. However, when needed, cross-ACC ATFM is directly managed by TMUs at ACCs and select TRACON facilities that use ATFM automation platforms and tools to help ensure smooth flows across the NAS.

2.5 TMUs have the following TBFM tools at their disposal when managing ATFM within ACCs or across ACC boundaries:

- *Departure Scheduling* helps determine departure release time (runway-off time) for an aircraft and any ground delay that may be needed for its smooth merging into a specific airborne constraint point. Departure Scheduling can be used for managing flows through multiple constraint points as well as for different types of constraints, including merge points into the overhead stream, merge points along the boundary with downstream ACCs, or merge points at entry to terminal airspace at arrival airports. Departure Scheduling can be coordinated between Air Traffic Control Tower (ATCT) and ACC TMU staff via voice or electronically at select locations in the NAS via *Integrated Departure and Arrival Capability* TFMS tool.

- *Arrival Metering* provides en route controllers decision support tools to manage time-based schedule for airborne flights destined to a specific arrival airport. Arrival Metering maintains a timed sequence of aircraft through individual arrival meter fixes—merge points on entry to terminal area illustrated as orange points along the black line encircling the Denver airport in *Figure 1*. These sequences include both already airborne aircraft (typically, from origins that are more than 200 nautical miles away from the arrival airport) and those that were integrated by Departure Scheduling prior to their take-off (typically, for airport-pairs within 200 nautical miles of each other). TMU staff sets and manages timed sequences of aircraft for all constraint points within the ACC or the TRACON. Air Traffic Controllers, on the other hand, monitor time-based schedules on their displays only for those merge points that are under their control, and issue clearances to individual aircraft as needed to ensure safety and to comply to time-based schedules as possible between orange dashed-lines (arrival metering freeze-horizons) and merge points in *Figure 1*.

[3] *Scheduling* is a function that creates a time-based schedule for a constraint point—a timed sequence of aircraft with intervals between successive aircraft that are consistent with desired spacing and other parameters.
[4] *Metering* is a function that supports accurate execution of a time-based schedule.
[5] *Constraint Point* is a NAS resource where demand may exceed capacity or where merging of traffic flows occurs.

- *Extended Metering* also provides decision support tools to en route controllers to help with managing time-based schedule for airborne flights; however, extended metering significantly increases the distance over which compliance to time-based schedules is managed by introducing additional upstream constraint points illustrated with full and dashed red lines (extended metering arcs and extended metering freeze-horizons, respectively) in *Figure 1*.

- *Terminal Sequencing and Spacing (TSAS)* is a future TBFM tool that the FAA is considering for extending metering principles all the way to the arrival runway. With this tool, it will be possible to introduce additional constraint points inside terminal airspace to help maintain runway assignments and time-based schedules for individual runways. TSAS will provide more accurate trajectory modeling inside terminal airspace, and will consider Consolidated Wake Turbulence separation standard and aircraft equipage such as PBN when establishing runway-based aircraft sequences and schedules.

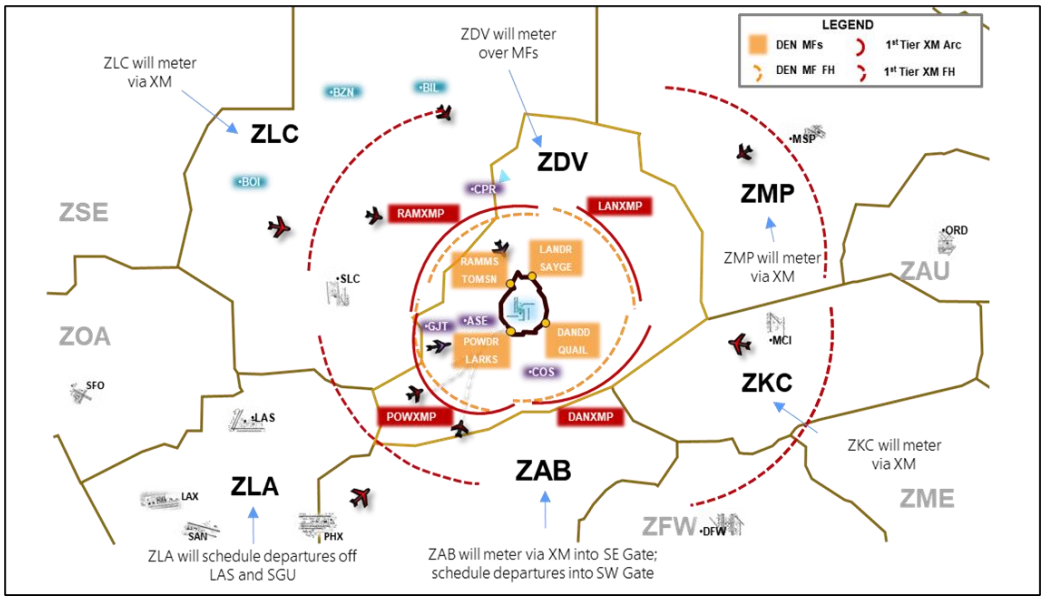

Figure 1. *Example of TBFM Adaptation for Arrival and Extended Metering at Denver ACC*

2.6 Each ACC TMU in the NAS has its own TBFM system. Data sharing occurs between TBFM systems at adjacent ACCs. In addition, ACC TMUs use National Traffic Management Log (NTML) to coordinate additional flow management activities, including Miles-in-Trail restrictions to manage sector volume and other TMMs. The NTML is a major player in capturing these TMMs, both in terms of their documentation and real-time electronic coordination; note that such information is routed from NTML in TMU to the en route air traffic controllers via Electronic Status Information System. In addition, NTML can also be used by a downstream ACC to request that an upstream ACC reroutes certain flights for sector capacity or arrival fix balancing.

2.7 Supported by integration of 3Ts, data-sharing across systems and stakeholders increases situational awareness and improves predictability of operations. This further allows delays caused by capacity-to-demand imbalances to be more efficiently redistributed to prevent congestion and via least costly means (for instance, via ground delays, airborne speed adjustments or en route holding instead of holding and vectoring at low altitude inside arrival airport's terminal airspace).

3. PUBLICLY AVAILABLE OIS FOR DOMESTIC AND INTERNATIONAL OPERATIONS IN THE NAS

3.1 With its hierarchical approach to ATFM in the NAS, the FAA maximizes the value of varied accuracy of information and its use across planning horizons from Strategic to Tactical. With Strategic Traffic Management, the FAA sets the stage for the day-of operation days, even weeks, in advance; the strategic plan is continually updated as new information become available, with NAS-wide priorities and flow rates being set on the day-of operation and according to most up-to-date demand and weather forecasts. Tactical Route Management revises the strategic plan on the day-of operation with TMMs and adjustments to flow and flight management as needed to meet regional capacity-to-demand imbalances and operational conditions. Finally, shortly before each departure starts taxing for take-off, Tactical Management of their trajectories is accomplished through TBM as needed to address challenges on the day-of operation.

3.2 CDM is not just integral but also a necessary process to establish and maintain common awareness of demand and operating conditions in the NAS. This requires both dynamic and proactive collaboration across the strategic and tactical planning and execution horizons, as well as continuous and transparent review of events and lessons learned. In the early days of CDM, the FAA depended on phone-calls between stakeholders and distributed information storage and management. With small investments into developing a web-based platform that integrates information about operating conditions in the NAS, route availability and equipment status, situational awareness and effectiveness of traffic management decision-making were greatly improved not just for the FAA but across the stakeholders to. We now conduct a planning meeting via a webinar every two hours so all CDM stakeholders can see the same graphical depictions of weather (actual and forecasted), demand, capacity and other relevant information. Please refer to the publicly available https://nasstatus.faa.gov/ for more information on the current conditions and restriction in the NAS.

3.3 Through partnership between CANSO, ANSPs and stakeholders in the Latin America and Caribbean (LAC) region, the FAA also contributes to daily updates of publicly available information on CANSO Aeronautical Data Exchange Network of the Americas (CADENA) —a web-based, regional OIS that includes regional information about ATFM Daily Plan; TMMs; active reroutes and route database; airport delays; advisories; NOTAMs; notifications; contingency forms; airport/airspace capacity; informational material; etc. In addition to consolidating and standardizing the presentation of information that is already available on individual ANSP web-sites, CADENA restricts data-uploading privileges through access-control protocols that were jointly agreed-upon by all stakeholders, and reformats some of the information to present it in a consistent and more user-friendly formats such as digital maps. Please refer to the publicly available https://www.cadenaois.org for more information on the current conditions and restrictions as reported by the stakeholders in the LAC region.

3.4 The FAA provides TFMS and TBFM data to CDM members and Nav Canada via an access-controlled, web-based platform, and is investigating requirements for extending access to other international air navigation service providers (for instance, anonymization of flights). This platform does not provide a direct access to FAA's operational systems but repackages select data that is ingested from operational systems for stakeholder read-only access on the web-based platform for review and consideration in their decision-making. Finally, TFMS, TBFM and TFDM data is also available via System Wide Information Management (SWIM) feed for those stakeholders who want to build their own tools to visualize data.

4. ACTION BY THE MEETING

4.1 The meeting is invited to:

a) note the information contained in this paper;

b) expand collaboration on cross-border ATFM in the Asia-Pacific region;

c) establish a process and a platform for integrated OIS to support regional CDM on a daily basis; and

d) discuss any relevant matters as appropriate.

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