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

ENHANCING ATFM BY ADDRESSING CHALLENGES AND EXPLORING SOLUTIONS

(Presented by China)

SUMMARY

This paper presents the analysis of current operational challenges in ATFM within the Asia-Pacific region. It specifically addresses ten aspects, including 4D trajectory prediction, principles of CTOT calculation, CTOT quality and availability, balancing CTOT stability with ATFM objectives, lead time considerations, flight plan issues, CTOT compliance rates, solutions for multi-constraint scenarios, long-range ATFM, and basic information exchange. These challenges serve as contributors for continuous improvement and procedural advancements in Asia-Pacific ATFM. The paper concludes by advocating for the development of ATFM guidelines tailored to the region, facilitating the construction and enhancement of individual ATFM systems.

1. INTRODUCTION

1.1 ATFM in the Asia-Pacific region is undergoing a transformative process from concept of operations to daily operations. This evolution is marked by a gradual refinement and enhancement, reflecting new characteristics that emerge during actual operations. It is a process that seamlessly integrates theory with practice, signifying the maturation of ATFM in the Asia-Pacific region. An important task in perfecting the ATFM operational system is the periodic and systematic analysis and summarization of issues and challenges encountered during its implementation.

1.2 Many of the challenges faced in the operation of ATFM in the region are relative concepts, closely linked to the capabilities of ATFM. As the actual operational capabilities of ATFM in the Asia-Pacific region improve, not only will the ATFM network become more comprehensive, but the depth of ATFM coverage will also expand progressively. Enhancing ATFM capabilities requires a gradual study and analysis of the actual challenges within the ATFM framework of ICAO, leading to a regional consensus on problem-solving. This will contribute to the overall enhancement of the region's capabilities, and existing challenges will be resolved as comprehensive abilities improve.

1.3 In the actual operation of ATFM, the process of establishing ATFM measures differs from their execution. The establishment process typically involves devising a series of ATFM measures based on a preset, relatively stable scenario with little variability. However, the execution of these measures is dynamic. Transitioning seamlessly from a static, preset scenario to a dynamic operational scene is a significant challenge for ATFM in the Asia-Pacific region today. This paper will also analyze the specific challenges faced in operations, thereby promoting the maturity and perfection of ATFM in the region.

2. DISCUSSION

4D Trajectory Prediction Accuracy

2.1 The extensive distribution and close interconnectivity of airports in the Asia-Pacific region necessitate a broader scope for ATFM network compared to other regions. This has imposed higher demands on one of the foundational elements of CTOT calculations: the 4D trajectory prediction. The key aspects of 4D trajectory prediction in the Asia-Pacific region currently focus on two areas: the methods of predicting 4D trajectories and the information required for such predictions.

2.2 In terms of 4D trajectory prediction methods, it is challenging for the BADA model, historical data, simulation models, Estimated Elapsed Times (EET) from Flight Plans, and combined corrections to cover all scenarios comprehensively. For instance, there can be discrepancies in the accuracy of EET information provided by different airlines, and some FPLs may have incomplete EET data. The reliability of EETs can also be negated by necessary ATC intervention actions for traffic management and separation (eg: vectors, non-preferred flight levels). As for the information needed for 4D trajectory prediction, the quality of information in air traffic control operating procedures, FPL messages, and the extent of sharing ATFM information all impact the accuracy of 4D trajectory prediction.

2.3 The accuracy of current 4D trajectory predictions, especially for long-haul flights, significantly influences the predictability and accuracy of CTOT calculations. Different States/Administrations have their methodologies and logic for 4D trajectory prediction, and there are variations in the priority given to the credibility of data used in these calculations. Therefore, one of the foundational tasks in advancing Asia-Pacific ATFM is to share information and calculation principles to enhance the overall precision of 4D trajectory predictions.

Principles of CTOT Calculation

2.4 In the operation of Asia-Pacific ATFM the fairness and reasonableness of CTOT calculation are critical concerns for airlines. These considerations primarily depend on the CTOT algorithm. Different States/Administrations have their unique principles and algorithms for CTOT calculation, and there are also variations in individual and batch calculations. The opacity of these different national algorithms and calculation principles can lead to confusion for airlines during execution. For instance, why a flight with an earlier EOBT receives a CTOT later in the sequence. Therefore, sharing the calculation principles among stakeholders not only mitigates difficulties for relevant stakeholders but also facilitates algorithm optimization. Additionally, it serves as a valuable reference for States/Administrations that have yet to establish comprehensive ATFM tools.

Quality and Availability of CTOT

2.5 The execution of cross-border ATFM measures is typically realized through the CTOT, and ensuring that ATFM measures achieve their intended effects depends not only on the proper execution of the CTOT but also on the quality of the CTOT at the time of its creation. In the Asia-Pacific region, the focus often lies on whether the CTOT is well-executed, with its calculation usually being an internal matter within a node. However, for the same scenario and ATFM measure, different algorithms or methods can result in varying CTOTs, which directly affects whether the ATFM measures can achieve their expected outcomes.

2.6 While calculating a CTOT is relatively straightforward, calculating an optimal CTOT, especially under the overlay of multiple ATFM measures to satisfy various requirements, is considerably more challenging. The executability of the CTOT, the fairness, expected outcomes, and flexibility of ATFM measures are all closely linked to the quality of the CTOT calculation. Research in algorithms and other areas within the ATFM system will greatly aid in generating high-quality CTOTs.

The Balance Point between CTOT Stability and ATFM Objectives

2.7 The stability of CTOT is crucial for the predictability of ATM operations and ATFM networks. However, excessive stability can reduce the overall flexibility of the ATFM network, leading to a diminished ability to adapt to changes. For instance, when a few flights deviate from their CTOT or when pop-up flights occur, it may result in failure to meet ATFM expectations. To maintain the flexibility of the ATFM network, an ATFM measure often needs accompanying adjustment factors. For example, in China, airborne holding is the adjustment factor during GDP implementation. The presence of adjustment factors helps maintain the flexibility of the ATFM network to achieve ATFM expectations.

2.8 In cases of restricted airspace capacity where airborne holding is not suitable and there are no domestic or nearby flights to act as adjustment factors, flights that have been assigned CTOT but have not yet boarded passengers are more suitable as adjustment factors to ensure the flexibility of the traffic management network.

2.9 Typically, stakeholders prefer minimal CTOT variability or reduced variability. However, locking CTOT at the time of issuance significantly reduces the flexibility of the ATFM network. Hence, there is a need to reach consensus on the locking time to strike a balance between CTOT stability and ATFM objectives. Meanwhile, China has implemented a series of auxiliary measures to ensure CTOT stability, such as handling minor deviations (currently set at 15 minutes in China) within the system without externally publishing modifications to CTOT information.

Lead Time for CTOT

2.10 The lead time for the release of CTOT is a critical metric for all stakeholders involved in ATFM network. It is an essential element in the execution of ATFM measures, significantly benefiting the predictability of ATFM network. However, finding the right balance is crucial, as CTOTs released too early are based on the operational environment and scenarios at the time of issuance. As time progresses, the operational scenario becomes clearer, and new changes may arise, making the CTOT more accurate as the departure time approaches. In practice, the Asia-Pacific region uses a 90-minute lead time as the standard for releasing CTOTs. In China, this time is often set earlier to incrementally increase the predictability of the entire ATFM network by adopting a phased approach to ensure stability.

2.11 In the operational practice of Asia-Pacific ATFM, there are generally four reasons for a CTOT being less than 90 minutes based on post operations analysis: late submission and/or distribution of flight plans, the lead time for issuing ATFM measures being less than "flight duration + 90 minutes," delays in CTOT transmission between systems, and differences in system algorithms, such as phased batch calculation of CTOTs, which can also cause issues. It is evident that the lead time for CTOT is closely related to the comprehensive ability of ATFM.

Lead Time Issues with Flight Plans

2.12 The Asia-Pacific region recommends submitting flight plans three hours before the EOBT (unless there are genuine operational or technical reasons),, a requirement clearly stated in the AIP of some States/Administrations. However, due to the varying pace of civil aviation development across the Asia-Pacific, there are differences in the execution by different stakeholders. Post operations analysis reveals that these differences are not only evident among various States/Administrations but are more pronounced across different airports. Late submission and or/distribution of flight plans, which affects predictability and significantly impacts ATFM measures, is the most common reason for insufficient CTOT lead times. To encourage timely submission and or/distribution of FPLs, especially at airports where some airlines face difficulties, a phased approach is recommended, starting with

ensuring submission at least 90 minutes before, gradually advancing to 120 minutes, and eventually aiming for a three-hour lead time.

CTOT Compliance Rates

2.13 The compliance rate for CTOT is fundamental to achieving the desired outcomes of ATFM measures, requiring the collaborative efforts of all stakeholders involved. A lower compliance rate not only fails to meet expectations but also reduces the fairness of ATFM measures, thereby diminishing trust in them. In practice, when low compliance rates occur, the reasons are manifold, including issues with CTOT executability, excessive delays caused by CTOT, ensuring mechanisms during CTOT execution, and delays in transmitting CTOT to the facilitating ATFM units. As Asia-Pacific ATFM progresses, it is advisable to consider gradually refining the recommended standards for CTOT compliance rates. For instance, different levels of compliance rates could be set according to the severity of the ATFM measures, such as over 85% for Category A measures and over 75% for Category B measures. When compliance rates fall short, meaning ATFM goals are not met, the initiating ATFM unit of the ATFM measures will consider alternative measures.

Solutions for Multi-Constraint Scenarios

2.14 Conflicting ATFM measures are one of the main challenges in current ATFM operations. This issue is closely related to ATFM concepts, methods, and tools, but the core problem lies in handling complex ATFM scenarios. While CDM or operating procedures are effective means to resolve conflicting ATFM measures, as complexity increases, sacrificing one or more measures to satisfy higher-priority ones may no longer be applicable in many scenarios. Therefore, ATFM measures should have the capacity to be satisfied simultaneously, meaning multiple interrelated ATFM measures can be conflict-free.

2.15 Since the introduction of the One CTOT Solution (OCS) operational concept, coupled with specific implementation methods such as the Collaborative Multi-constraint Conversion Program (CMCP), the practice of achieving a CTOT that satisfies all ATFM measure constraints has been thoroughly validated and has resolved issues during operations. As for who executes the CMCP program, it is an open-ended task; any ATFM unit can become the ATFM Harmony Unit (AHU) within the CMCP loop, allowing all ATFM units to participate according to their capabilities and needs, consistent with the distributed multi-nodal ATFM operational concept of the Asia-Pacific region.

Long Range ATFM

2.16 The traffic flow structure of the Asia-Pacific region dictates that long-range ATFM is a significant aspect of the region's overall ATFM efforts. Stakeholders such as CANSO are actively and effectively advancing the operational concepts and addressing the challenges of long-range ATFM. However, within the Asia-Pacific ATFM operations, these concepts still require further analysis and validation. In practice, there is a divergence in the perception of "long-range," with some stakeholders believing that conventional ATFM measures can cover some certain area, while others disagree. This discrepancy is closely linked to ATFM capabilities; stronger predictive and computational abilities, such as improved weather forecasting and high-precision 4D trajectory predictions for long-range flights, naturally extend the coverage of ATFM measures. Therefore, the concepts of "long" and "short" are relative, and ATFM measures can adjust the definitions of these terms based on capabilities. Additionally, the ATFM Harmony Unit (AHU) can facilitate the relay of ATFM, effectively extending the network's coverage to a more long range.

Basic Information Exchange

2.17 Information exchange has always been a focal point for ATFM in the Asia-Pacific region. For the future ATFM system, the region has well-planned expectations based on frameworks like the

System Wide Information Management (SWIM). Achieving comprehensive information exchange across the entire region will require a considerable amount of time. Currently, information exchange in ATFM remains at a more rudimentary stage, involving FPL, DEP, CTOT, capacity and so on, creating a contrast between long-term expectations and present realities. While achieving comprehensive information exchange in one step would be ideal, considering the current state of ATFM in the Asia-Pacific region, a phased approach is still necessary. In the short to medium term, it is recommended to gradually advance the exchange of basic information that significantly impacts ATFM measures, such as flight schedules and key milestone events in ACDM, starting with the most pressing issues and progressively promoting comprehensive information exchange related to ATFM.

Operational Guidelines for ATFM

2.18 For States/Administrations that have established ATFM systems, there is a need for a gradual improvement process for their tools, operating mechanisms, and personnel capabilities. Those yet to establish comprehensive ATFM systems require more experience and references to reduce costs and increase efficiency. As a collective entity, the enhancement of the Asia-Pacific's ATFM capabilities should be a unified process. The experiences and lessons learned by States/Administrations that initiated ATFM efforts are worth sharing. Concurrently, as ATFM in the Asia-Pacific region is based on a shared concept, the tools, mechanisms, and personnel involved in the construction of individual systems should align as much as possible with those of other States/Administrations in the Asia-Pacific region, thus creating a synergistic force for regional ATFM development. Therefore, it is advisable to develop operational guidelines for ATFM in the Asia-Pacific region from an operational perspective, providing a template for States/Administrations to construct and refine their ATFM systems according to this roadmap and their specific circumstances.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) recommend considering the development of operational guidelines for ATFM in the Asia-Pacific region;

c) recommend that stakeholders collaborate in sharing challenges and experiences encountered during ATFM operations;

d) discuss any relevant matters as appropriate.

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