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Agenda Item 3: Air Navigation System Performance Improvement
3.1: Proposals to improve the efficiency of air navigation services contributing to LTAG

STATUS AND ROADMAP OF THE DEVELOPMENT OF AIR TRAFFIC FLOW MANAGEMENT IN CHINA

(Presented by China)

EXECUTIVE SUMMARY

The paper gives an update on the development of air traffic flow management (ATFM) in China, including a description of the operational concepts of ATFM in China and an overview of the national traffic flow management system. It also describes the concept of One Calculated take-off time (CTOT) Solution, which aims to resolve the conflicts between multiple simultaneous ATFM measures, and aspects of cross-border ATFM collaboration. The overarching goal is to collaborate with all stakeholders to collectively advance the development of regional ATFM.

1. INTRODUCTION

1.1 ATFM Center of Operations Management Center of Air Traffic Management Bureau of Civil Aviation Administration of China (CAAC) has been in operation for four years. With over 86 workstations in a 2 000 square meter workspace, it organizes and implements national civil aviation ATFM and foreign-related flow management. On 20 May 2021, the national traffic flow management system was officially deployed across the mainland of China, enabling nationwide integrated operation of the ATFM system and operating procedures. The Air Traffic Management Bureau of CAAC is responsible for the specific organization and implementation of national civil aviation air traffic flow management and foreign-related flow management. The regional administration of civil aviation is responsible for the supervision and inspection of civil aviation air traffic flow management within its jurisdiction.

1.2 The deployment and use of the national traffic flow management system in China has ushered in a new stage for civil aviation in China, characterized by unified situational awareness and collaborative decision-making. As the operation of the system becomes increasingly efficient, and the implementation of cross-border ATFM collaboration, rapid simulations and human-in-the-loop tests of cross-border ATFM have been carried out by ATFM units.

¹ Chinese and English versions provided by China.

1.3 In operating the cross-border platform of the national traffic flow management system, it was found that given the actual circumstances of the Asia and Pacific Region where China is located, implementing ground delay programme (GDP) and other ATFM measures indiscriminately for domestic and international flights cannot effectively achieve information-sharing and cross-border collaboration. Therefore, China has sought to gradually promote the planning of the One CTOT Solution, Collaborative Multi-Constraint Conversion Program, and ATFM Harmony Unit, and their gradual implementation in the Asia and Pacific Region based on a holistic approach.

2. DISCUSSION

2.1 Operational Concepts

2.1.1 *Concept Development:* The ATFM operational system in China follows a “two-level decision-making and one-level implementation” model. Before 2020, air traffic flow management was carried out primarily by the seven regional Air Traffic Management Bureaus, each with its own ATFM system. The national ATFM unit monitored and coordinated the activities of the seven bureaus, and the information-sharing across the country was achieved through the previous air traffic operation management system. After 2020, with the deployment of national traffic flow management across the mainland of China, a common situational awareness has been established. The Operations Management Center now assumes full responsibilities for nationwide ATFM operations.

2.1.2 *ATFM Process:* Collaborative decision-making-based ATFM requires joint efforts of ATFM units at all levels to achieve optimal performance. Given the characteristics and development goals of civil aviation operations in China, a single ATFM measure is insufficient to address the demand and capacity imbalance. Instead, it is necessary to leverage the advantages of the entire ATFM system to deal with different scenarios. It is appropriate to make use of collaboration among stakeholders to develop a better-suited ATFM solution to accommodate the anticipated rapid growth of flight movements in China.

2.1.3 *Fundamental Concept of ATFM:* ATFM is a service established for the safe, orderly and fast flow of air traffic. It manages the temporal and spatial distribution of air traffic flows through monitoring, analysis, decision-making, implementation, and evaluation. This process maximizes the use of the air traffic management (ATM) system capacity without overload, optimizes traffic flow distribution, maintains demand-and-capacity balancing (DCB) through scientific deployments, and aims to improve airspace utilization and reduce congestion and flight delays.

2.1.4 *Operational Concepts:* The Centralized Multi-Participant Collaborative ATFM Network is the main ATFM operational concept in China. It encompasses a centralized ATFM network that provides ATFM services for domestic flights and connects with cross-border ATFM through nationally unified, advanced and integrated ATFM / collaborative decision-making (CDM) procedures and systems; multiple operational nodes where, after the national ATFM unit generates ATFM solutions based on collaborative decision-making, the seven regional ATFM nodes in China facilitate the execution of the decisions made, and regional ATFM units can also make their own decisions in each region; and CDM with stakeholders, which enables a common situational awareness among all stakeholders to carry out multi-party collaborative decision-making, thereby providing a more feasible ATFM solution.

2.2 National traffic flow management system

2.2.1 The national traffic flow management is a unified ATFM system developed based on the concept of ATFM in China. It is deployed in the Operations Management Center, the seven regional ATFM units, and 36 ATM sub-bureaus and stations, covering the entire ATM system in China. With the Operations Management Center as the hub, supported by regional ATFM units, and extended by the ATFM units

located in the area control centre, approach control, and aerodrome control tower, national traffic flow management has formed a collaborative ATFM system that covers all civil aviation entities in China and that could effectively connect with cross-border ATFM in the Asia and Pacific Region.

2.2.2 The Flight Plan Processing Center of the Air Traffic Management Bureau, CAAC provides flight plan information for national traffic flow management. Information from the aeronautical information service system, meteorological information system, air traffic control automation system, tower electronic flight strips, surface movement radar, and other sources are used as input for national traffic flow management. In addition, as an important link in the ATFM system, national traffic flow management also interacts with airport CDM (A-CDM), arrival manager (AMAN) / departure manager (DMAN), and other related systems. CTOTs of the regulated flights are automatically released to airspace users, airport operators, and electronic flight strips through the interconnection of related systems to achieve automatic information-sharing with ATFM stakeholders.

2.2.3 National traffic flow management covers the strategic, pre-tactical, and tactical stages of the ATFM execution phase, as well as the ATFM post-operation analysis. It also provides calculated proposals for the ATM planning phase. National traffic flow management provides automatic evaluation recommendations for operational capacity based on the measures issued on similar days and simulations and makes them available to the cross-border ATFM cooperation platform. It also provides operational information system services for areas where transmission between systems is impossible.

2.2.4 Based on national traffic flow management, ATFM measures in China have transitioned from being separation-based to capacity-based. When it is impossible to increase capacity and there is a need to manage traffic flow, national traffic flow management provides flow management positions with a series of optional ATFM measures such as GDP, airspace flow procedure, ground stop, miles-in-trail (MIT), level capping plus MIT, and collaborative rerouting. ATFM personnel can simulate these measures and assess their possible impact. Then, one measure or a group of measures are selected to form an ATFM solution. It is worth mentioning that when a flight is subject to multiple ATFM measures or restrictions, the slot calculation of national traffic flow management could fully consider the requirements of each measure/restriction based on the concept of One CTOT Solution proposed by China to generate a CTOT that complies with multiple measures/restrictions.

2.2.5 While building the national traffic flow management system, China also pays attention to the construction of the whole ATFM system. China has deployed A-CDM at airports with a passenger throughput of more than 10 million. China has also strengthened the construction of AMAN and DMAN responding to a complete ATFM-related system. Meanwhile, China also issued the *Regulations on ATFM of Civil Aviation*, *Operation Rules of ATFM in China (trial implementation)* and the *Regulations on the Management of Civil Aviation Air Traffic Flow* to standardize ATFM operations and gradually create an efficient ATFM collaborative operation environment.

2.3 ATFM solutions

2.3.1 As civil aviation in the Asia Pacific Region gradually recovers since last year, traffic volume is transitioning from rapid recovery to new high-speed growth. The region, with its complex operating environment and diversified demands for ATFM, will experience a capacity-demand imbalance. The situation is further complicated by the distinctive characteristics or conditions of the States/administrations in the Region, each with its unique operational challenges and ATFM requirements.

2.3.2 Additionally, multiple ATFM measures may be simultaneously issued to the same traffic flow or flight, leading to conflicting ATFM measures. This conflict is a hot topic in the field of ATFM and presents an emerging issue to be considered in the next stage of cross-border ATFM in the Asia and Pacific Region. Some air navigation services providers (ANSPs) have their own solutions to these problems, such

as determining the most penalizing regulation, or issuing an ATFM measure based on regional coordination. These solutions, while innovative, highlight the need for a more unified approach to managing ATFM measures.

2.3.3 However, these methods only address conflicting ATFM measures to some extent, and there are still challenges due to the number of ATFM measures and complex operating environments. On one hand, there are difficulties in communication and coordination for ATFM measures, especially when these measures are taken by different ANSPs. On the other hand, even though a better-suited ATFM measure is selected, there still exists the problem that a great deal of flights are unable to satisfy all of the ATFM measures that need to be complied at the same time. This highlights the need for a more comprehensive and flexible approach to ATFM measure selection and implementation.

2.3.4 The concept of One CTOT Solution aims to resolve these conflicts. By upgrading the collaborative MIT conversion program to the collaborative multi-constraint conversion program, the CTOT of every flight can meet all constraints, eliminating the need to select or coordinate for ATFM measures that need to be executed. This innovative approach represents a significant advancement in the field of ATFM, avoids unnecessary amplification of restrictions, and demonstrates China's commitment to improving air traffic management efficiency.

2.3.5 CTOT is calculated by the collaborative MIT conversion program, which is generally supported by the system and has high compatibility. ATFM units without computing capabilities can use conventional approaches. When ATFM units with computing capabilities face traffic flow constraints and need to issue ATFM measures, they can calculate the CTOT which meets all overlapped constraints on this traffic flow. Therefore, only one CTOT should be issued no matter how many ATFM measures are imposed on the same flight. This approach reflects a transition of ATFM measures from implementation coordination to a solution that satisfies all constraints, and a shift from "conflicting" ATFM measures to "synergic" ATFM measures.

2.4 ATFM Collaboration

2.4.1 ATFM is a key efficiency improvement method for air traffic management and plays a crucial role in the implementation of the plan. In recent years, ATFM development in China has not only focused on domestic ATFM but also emphasized the harmonized development between cross-border and domestic ATFM under the ICAO ATFM framework in the Asia and Pacific Region. China has been actively participating in cross-border ATFM collaboration, and has been progressively carrying out cross-border ATFM projects and follow-up planning activities in a more pragmatic and systematic way.

2.4.2 The operating mode of ATFM in China has been designed based on ICAO's ATFM framework. There are both similarities and differences between China and other States and regions in terms of ATFM operational concepts, workflows, and ATFM measures. Therefore, strengthening the understanding of ATFM in China and seeking common ground while reserving differences is the basis for collaborative ATFM operation in future.

2.4.3 National traffic flow management which integrates a huge amount of ATFM information is not isolated; instead, it is a part of the Asia and Pacific ATFM network and a component of the global network. Therefore, China is willing to promote interconnection with ATFM information networks of all States and administrative regions in the Asia and Pacific Region under the framework of ICAO. With the further development of cross-border ATFM collaboration, the network of cross-border ATFM system can not only expand information interaction but also sharply promote operational efficiency. Thus, we welcome all stakeholders to carry out tests on interconnecting with China's ATFM system to enable information exchange.

3. **CONCLUSION**

3.1 The Conference is invited to note the information contained in this paper.

3.2 China has achieved the national integrated operation of ATFM systems and procedures.

3.3 Prove that in the operation of national traffic flow management, One CTOT Solution is the effective method to solve multiple ATFM measures.

3.4 All stakeholders are invited to carry out tests on interconnecting with China's ATFM system to enable information exchange.

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