



ICAO

International Civil Aviation Organization

Fourteenth Meeting of the Air Traffic Management Sub-Group (ATM/SG/14) of APANPIRG

Bangkok, Thailand, 3 – 7 August 2026

Agenda Item 5: ATM and CNS Systems Modernization

PREPARING FOR TRAJECTORY-BASED OPERATIONS THROUGH CARATS, DATA ANALYTICS AND REGIONAL COOPERATION

(Presented by Japan)

SUMMARY

This IP highlights our past achievements, including the reorganization of domestic airspace and our experience in analyzing issues and improving operations using data, and provides an overview of our current initiatives, including the launch of SWIM operations, toward the future implementation of Trajectory-Based Operations (hereinafter referred to as "TBO").

1. INTRODUCTION

1.1 In 2010, we formulated CARATS (Collaborative Actions for Renovation of Air Traffic Systems) as long-term vision for future air traffic systems, undertaking efforts to reorganize domestic airspace, introduce data communications, advance communication, navigation, surveillance technologies and information systems, and improve operations by leveraging these advancements.

1.2 Since the formulation of CARATS, the environment surrounding Japan's air traffic system has undergone significant changes, including not only growing air travel demand but also shifts in passenger preferences following the COVID-19 pandemic, diversification of airspace usage needs, increasing calls for decarbonization, and advances in digital technology. In response to these shifting circumstances, and with the aim of realizing a convenient and sustainable air traffic system where an unwavering commitment to safety remains highest priority, we formulated the new CARATS2040 last year, establishing 2040 as the target year.

1.3 The previous year was the year we transitioned from the original CARATS to the new CARATS2040. Upon reviewing the outcomes of our long-term initiatives, we have addressed the ongoing challenges inherited from the original CARATS while simultaneously launching new initiatives. This includes the completion of the reorganization of domestic airspaces in response to the increase in air traffic. Japan remains committed to ensuring safety and security while leveraging advanced technologies to deliver seamless and efficient aircraft operations to accommodate expanding air traffic.

2. DISCUSSION

Data-Driven Operational Improvements and Sector Optimization

2.1 Last year, which was the first year of CARATS2040, we completed the vertical division of its domestic airspace. This was the result of more than a decade of effort. After analyzing the breakdown of increasing traffic demand and focusing on the growing number of international flights arriving at and departing from airports in Japan, as well as aircrafts transiting through the Fukuoka FIR, we have resolved to develop a plan to restructure the airspace through a vertical stratification into upper and lower layers for its optimization. Specifically, the plan involved partitioning the airspace into a higher altitude layer, primarily designated for over flights, and a lower altitude layer, dedicated exclusively to climb and descent operations around airports. (**Figure 1**)

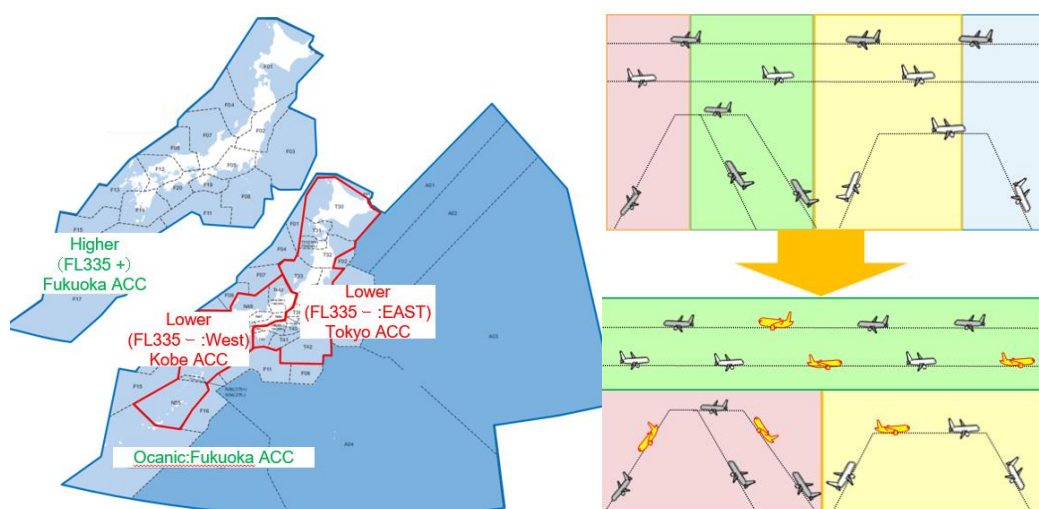


Figure 1. Conceptual Airspace Structure Before and After Vertical Stratification

2.2 As a result of the airspace restructuring, an operational environment capable of addressing the aviation demand required at present has been generally established. Meanwhile, due to unanticipated shifts in circumstances, there has been a growing frequency of the aforementioned international flights and overflights concentrating on major air routes, resulting in unforeseen congestion within specific sectors that was not projected during the initial planning phase of the airspace restructuring.

2.3 Under the CARATS2040 framework, specific indicators are established for each domain, such as punctuality, to comprehensively monitor the progress and efficacy of measures. Through quantitative and qualitative analyses based on these indicators, a structured framework has been instituted to conduct regular status assessments and evaluations. Evaluating the effectiveness of measures through analyses of indicators and operational data, and leveraging these findings for continuous operational improvements, is positioned as a highly effective approach to accommodating expanding air traffic demand and increasingly sophisticated operations.

2.4 In the context of Japan's airspace restructuring, analyses based on these indicators have enabled us to assess the status of aviation demand and airspace capacity, as well as to identify operational bottlenecks, by reflecting these outcomes in operational improvements and policy revisions, we addressed the issue of congested sectors. For instance, regarding congested high-altitude sectors, we analyzed the traffic distribution in surrounding sectors then restructured the sector configurations to align with shifting aviation demand. Through these measures, we sought to balance traffic flows while striving to mitigate impacts from traffic flow management and maximize the utilization of FIR airspace capacity. (**Figure 2**)

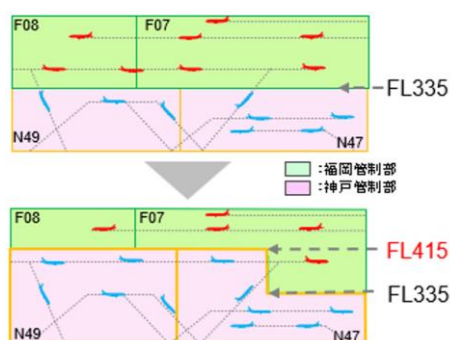


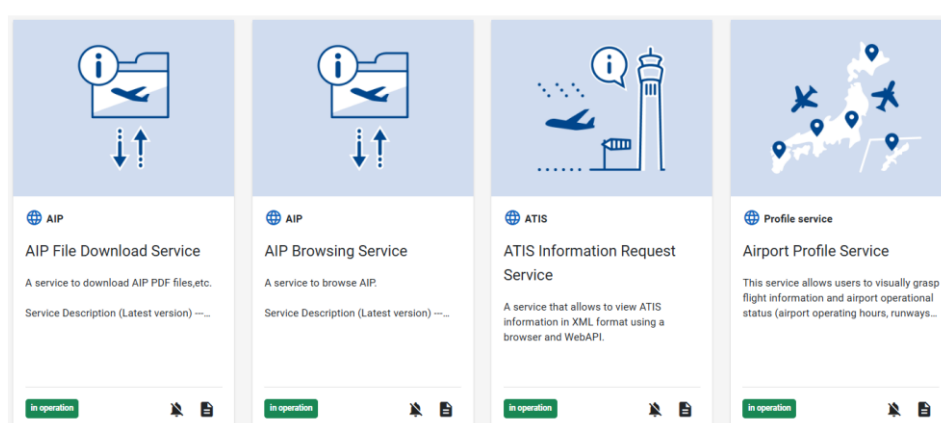
Figure 2. Sector Reconfiguration Based on Traffic Demand Analysis

Launch of SWIM Operations

2.5 With the continued growth in air traffic demand, the importance of information sharing in air traffic management has been further increasing. Traditionally, the information shared between operators and air traffic control authorities has been limited, and the inability of both parties to fully understand each other's operational situation has been identified as a factor that may lead to inefficient operations and delays.

2.6 To address this issue, a transition is being made from conventional text-based information exchange to standardized, machine-readable digital information services, thereby enhancing safety, efficiency, capacity, and predictability. In this context, System-Wide Information Management (SWIM) is positioned as the foundational information infrastructure enabling such transformation.

2.7 Japan's SWIM implementation is being advanced in a phased manner, based on the principle of coexistence with existing systems. Japan's SWIM enables the collection, management, and provision of aeronautical, meteorological, and operational information in standardized formats, and is characterized by an Internet-based, service-oriented architecture. On 4 March 2026, Japan launched SWIM information services, including Digital NOTAM, AIP, meteorological information, flight plan and ATS information, as well as integrated visualization services, which are provided through a SWIM portal. (**Figure 3**)



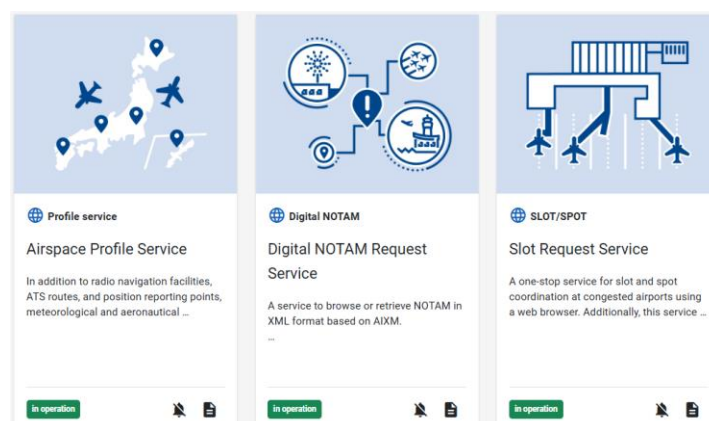


Figure 3. Overview of Japan's SWIM Information Services

2.8 Furthermore, Japan has established a SWIM governance framework and related rules, and is promoting enhanced situational awareness, improved operational efficiency, and collaborative decision-making through the operation of services such as digital aeronautical information, integrated airport and airspace information, and flight plan and ATS information services.

2.9 These services are designed to coexist with AMHS/AFTN while providing a foundation for the future introduction of ICAO concepts, including FF-ICE and, subsequently, TBO.

2.10 Looking ahead, Japan plans to further expand SWIM capabilities by enhancing information services, strengthening system-to-system connectivity, and advancing standardization and cybersecurity frameworks, in alignment with the ICAO APAC SWIM Implementation Roadmap.

Guiding Principles for the Promotion of TBO

2.11 Furthermore, to realize TBO, we are participating in a joint project within the APAC region called the TBO Pathfinder Project, promoting initiatives in cooperation with relevant states and international organizations. Under these frameworks, we are defining operational and technical requirements through the study of operational scenarios, tabletop exercises, and demonstration activities while validating international information-sharing procedures. We are also engaged in discussions on cost-benefit analyses to advance quantitative evaluations of operational efficiency improvements and fuel reduction efforts. Through these efforts, we are contributing to building a foundation for consistent implementation across the entire region.

2.12 To realize TBO, it is required to align strategic directions among stakeholders while defining the concepts and prerequisite for its implementation to accommodate future traffic volume growth and increasingly sophisticated operational environments. Particularly during the transitional phase where current and future operations coexist, challenges arise from unresolved technical requirements and operational procedures. Therefore, it is critical to systematically organize these considerations and foster mutual understanding among all parties. Furthermore, establishing a structured framework is essential to clarify the future vision and enable a progressive and consistent implementation.

2.13 The accumulation of knowledge and experience gained through international studies, demonstration activities, and domestic initiatives under both the conventional CARATS and the new CARATS2040 frameworks serves as the vital foundation for Japan's current efforts to define a concrete roadmap for TBO implementation. Going forward, we will progressively define operational requirements, technical requirements, and operational rules, and then compile and publish them in a format that can be shared among all stakeholders. Through these steps, we aim to define the progressive milestones toward TBO implementation and build a foundation that supports future air traffic

operations. Simultaneously, we remain committed to advancing initiatives toward regional TBO implementation under international cooperation.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) note the information contained in this paper.

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