International Civil Aviation Organization

Sixth Meeting of the Asia/Pacific Air Traffic Management Automation System Task Force (APAC ATMAS TF/6)

Bangkok, Thailand 2-4 June 2025

Agenda Item 5: ATM Automation System Implementation Experience by States

5.6. Development of New Technology

ENHANCEMENTS TO ATM AUTOMATION SYSTEM FOR SUPPORTING IPA

(Presented by China)

SUMMARY

In order to implement IPA (Independent Parallel Approaches), ATM automation system faces higher requirements in high-precision surveillance, separation management, and operational linkage. This paper proposes a solution for functional improvements to ATM automation system, which will be more conducive to the promotion and application of IPA operations at various airports.

1. INTRODUCTION

1.1 To enhance airport capacity and overcome airspace bottlenecks, independent parallel approaches have been introduced as an efficient operational mode. This approach effectively improves operational efficiency, optimizes airspace resources, and increases economic benefits.

1.2 However, independent parallel approaches impose higher demands on ATM automation systems in terms of high-precision surveillance, interval management, and operational coordination. This paper proposes functional improvements to ATM automation systems to address these requirements.

2. DISCUSSION

Challenges

2.1 Surveillance Accuracy Aspect

Currently, ATM surveillance relies mainly on radar and ADS-B. In air traffic control automation systems, the root mean square error (RMSE) of aircraft positions during straight-flight operations does not exceed 200 meter, with the maximum position error (99%) for straight-flying aircraft not exceeding 500 meters. Due to differing update cycles and accuracy between radar and ADS-B surveillance sources, the ATM automation system currently updates aircraft tracks at period of 4 seconds. Under IPA operations, the ATM automation system cannot provide the high-precision, high-update-rate tracking needed for the final approach segment.

2.2 Separation Management Aspect

Current radar-controlled minimum separation standards include 3 NM for approach and 5 NM for en-route operations. Within 10 NM of the runway threshold for final approach, a reduced 2.7 NM separation is applied. Under independent parallel approaches, the increased density of aircraft in terminal areas may trigger false alerts from conventional Short-Term Conflict Alert (STCA) mechanisms when adhering to the 3 NM approach separation standard, causing operational disruptions.

2.3 Operational Aspect

Implementing independent parallel approaches in ATM automation systems requires manual configuration of runway status, No Transgression Zone (NTZ) maps, alert areas, and suppression zones. These procedures are cumbersome and require corresponding adjustments in Tower Automation Systems (Internationally, it is referred to Integrated Tower Systems). Currently, operational synchronization between ATM Automation Systems and Tower Automation Systems remains incomplete.

Functional Improvements

2.4 In order to better support independent parallel approach operation, the air traffic control automation system can be optimized and improved in the following three aspects:

<u>High-Precision Surveillance and Display.</u>

2.5 For parallel runway centerline spacing:

a) Less than 4300 ft but not less than 3400 ft: Secondary surveillance radar (SSR) with azimuth accuracy not less than 0.06°, update cycle not more than 2.5 seconds, high-resolution displays with predictive position and deviation alerts.
b) Less than 5000 ft but not less than 4300 ft: SSR equipment meeting or exceeding the above specifications.
c) 5000 ft or more: Surveillance radar with azimuth accuracy Less than 0.3°, update cycle not more than 5 seconds.

2.6 Integration of Wide-Area Multilateration (WAM) and ADS-B signals will enable fused final approach tracks with high precision (1-second update cycles). A dedicated final approach monitoring position will feature enhanced situational displays and mandatory track takeover capabilities to ensure real-time monitoring and emergency response.

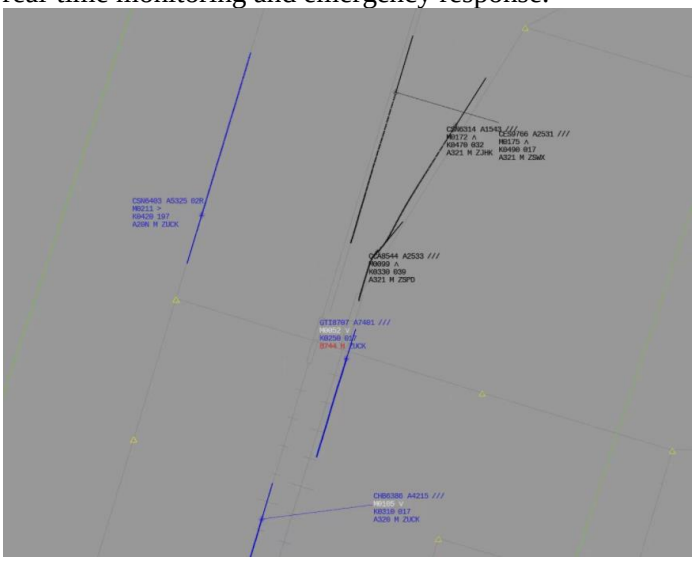

Figure 1: Final Approach Monitoring Position

Refined STCA Alerts in the Terminal Area

2.7 As shown in the figure below for an IPA scenario (dual-runway example), define Region 1 for runway 02L and Region 2 for runway 02R. In these areas, if the separation between any two aircraft is about to fall below the minimum required or has already fallen below it, the system issues a short-term conflict alert (STCA) (assuming a vertical separation above of 240 meters for the alert criteria) under the following rules.

a) Aircraft A and B using runway 02L have a minimum horizontal separation of 5 kilometer.
b) Aircraft D and E using runway 02R have a minimum horizontal separation of 5 kilometer.
c) There is no separation requirement between aircraft A and D, or between B and E (on different runways).
d) When aircraft C in Area 1 shows a tendency to stray out of Area 1, the minimum lateral separation between C and E becomes 5.6 kilometer.

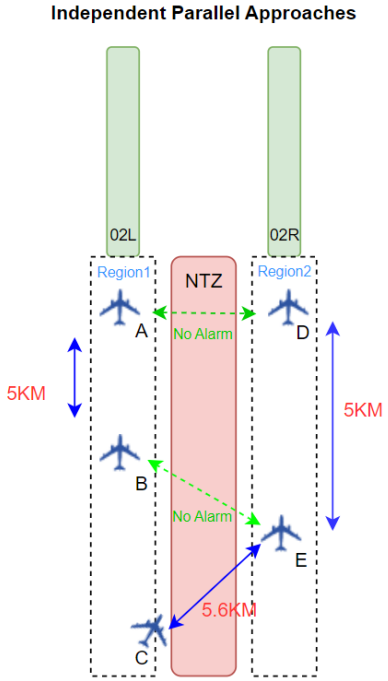

Figure 2. Refined STCA in Airport Area

Landing Aircraft Spacing Advisory Function

2.8 For two aircraft that have wake turbulence separation requirements, the system will calculate in real time—based on either the traditional wake turbulence categories or the RECAT-CN separation standards, combined with the lead aircraft's touchdown time and the relative speed of the two aircraft—and display, in front of the following aircraft's symbol, the position corresponding to the minimum wake turbulence separation behind the leader, as well as a wake turbulence separation warning marker. For two aircraft that have no wake turbulence separation requirement, the system will, according to the configured minimum spacing requirement and based on the lead's landing time and their relative speed, compute and display a recommended spacing position ahead of the following aircraft. This provides controllers with a refined spacing guidance on the final approach, facilitating optimal separation management between aircraft on that segment.

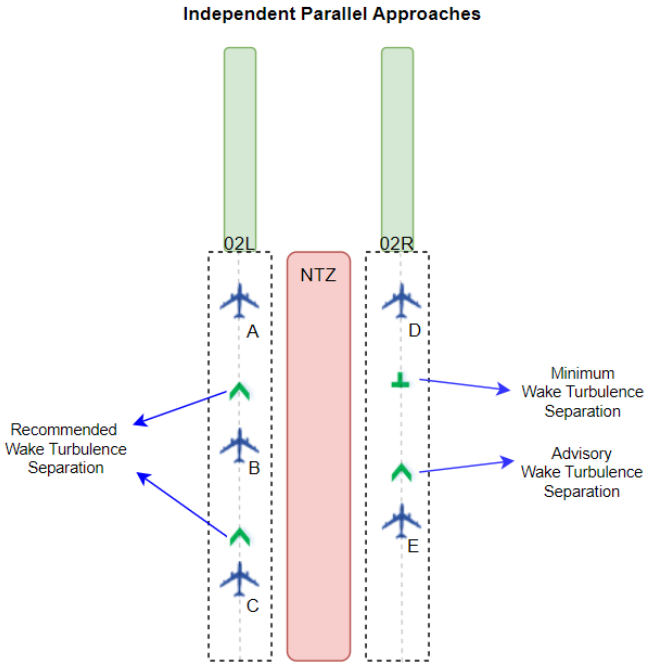

Figure 3. Landing Aircraft Spacing Advisory Function

IPA Mode

2.9 IPA operation mode is added to the system to achieve linked activation of functions such as NTZ enforcement, landing aircraft spacing management, and terminal-area refined STCA alerts.

2.10 ATM automation system can predefine multiple IPA operation configurations based on runway information. Each configuration includes the associated runways, runway operation mode, NTZ boundaries, STCA suppression zones, landing aircraft spacing advisories, and other related functions. When the supervisor controller activates the corresponding IPA mode at the supervisory console, the system automatically enables the associated runways, NTZs, alert suppression zones, landing spacing advisories, etc., thereby realizing one-click coordinated activation of all relevant functions.

2.11 When the ATM automation system and the Tower automation system are networked, the Tower automation system will one-way synchronize to the ATM automation system's selected IPA mode, achieving linked IPA mode operation across the systems. Otherwise, the ATM automation system and the Tower automation system each toggle their IPA operation mode separately on their own systems.

Outlook

2.12 The improvements in ATM automation system functionality during the final approach phase have achieved an increase in situational awareness accuracy, enhanced monitoring capability, and optimized separation management, providing more reliable support for IPA operations. These enhancements are currently undergoing verification testing in Chengdu and Chongqing.

2.13 Meanwhile, due to varying runway configurations and individualized operational requirements, the optimization solutions may not always be universally applicable. To support IPA operations better, further exploration is still needed in areas such as:

a) Final approach trajectory accuracy

b) Dynamic separation management
c) Decision-support capabilities

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matter as appropriate

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