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Bangkok, Thailand, 06 – 10 April 2026

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

ANALYSIS OF A CTO TRIAL IN FUKUOKA FIR
(Presented by Japan)

SUMMARY

This paper presents an update on a CTO (Calculated Time Over) trial conducted within the Fukuoka FIR. The analysis is based on approximately 2,800 flights and includes data-based observations of operational performance, cancellation factors, time accuracy, and operational considerations. The information is presented as a reference that may support ongoing considerations related to ATFM operations. The observations reflect operational conditions under which CTO was applied during the trial.

1. INTRODUCTION

1.1 Air Traffic Flow Management (ATFM) measures are applied to maintain a balance between traffic demand and available airspace capacity. CTO (Calculated Time Over) is one of the operational measures used in this context.

1.2 The operational conditions of the sectors in which aircraft operate may vary depending on weather conditions, traffic situations, and operational constraints. Accordingly, the effect of such measures may depend on these conditions. In addition, such measures are applied in coordination with tactical ATC operations conducted for safety purposes.

1.3 The objective of the analysis was to examine the application of CTO at designated fixes through speed control, and to review its operational characteristics under mixed traffic conditions.

1.4 The trial was conducted under the following conditions:

- a) Period: From March 2023 (ongoing)
- b) Target flights: Arrival flights from outside the FIR to Tokyo International Airport (RJTT), primarily at cruising levels (FL335 or above)
- c) Method: CTO achieved through speed control, implemented in parallel with CTOT-based flow control applied to departing domestic flights to Tokyo International Airport (RJTT)
- d) Exclusion conditions: Weather avoidance, altitude constraints, and aircraft unable to comply with speed instructions

Approximately 2,808 flights were included in the trial. Data collection is ongoing. The geographical scope of the trial and target fixes are illustrated in Figure 1.

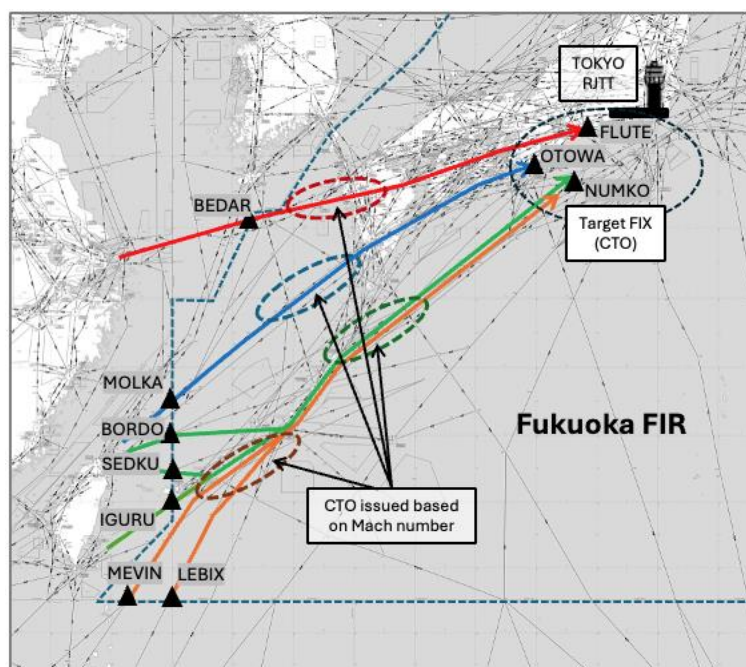


Figure 1 CTO Target Fixes in Fukuoka FIR

1.5 The analysis was conducted based on operational data collected during the trial. The evaluation focused on the following aspects:

- operational performance and CTO achievement;
- cancellation factors;
- operational interaction and considerations;
- ETA prediction accuracy and error characteristics.

2. DISCUSSION

Operational Performance and CTO Achievement

2.1 Based on the analysis of the collected data, assigned CTO were generally achieved within approximately ± 3 minutes. Out of 2,808 flights:

- 1,897 CTO assignments complied with assigned speed instructions; and
- 911 CTO assignments were cancelled.

2.2 The analysis indicates that a proportion of flights were subject to cancellation under certain operational conditions. This reflects the operational conditions observed during the trial. As shown in Figure 2, the distribution of flights with CTO applied varies by FIR entry fixes, with a relatively higher proportion of traffic observed via specific entry fixes.

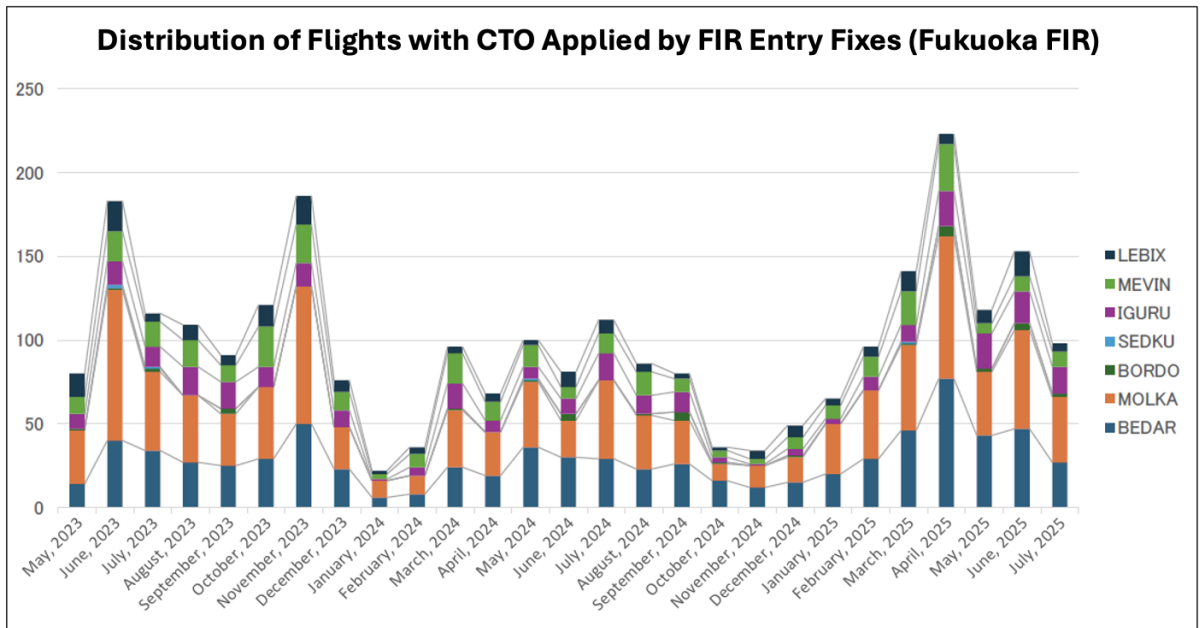


Figure 2 Distribution of Flights with CTO Applied by FIR entry fixes

Cancellation Factors

2.3 The analysis indicates that cancellations were observed under various operational conditions. The main factors related to cancellations included:

- weather avoidance;
- tactical ATC interventions for separation;
- altitude constraints.

2.4 Variations in delay allocation through CTO were observed, reflecting changes in the number of CTO cancellations. As shown in Figure 3, variations in delay characteristics were also observed.

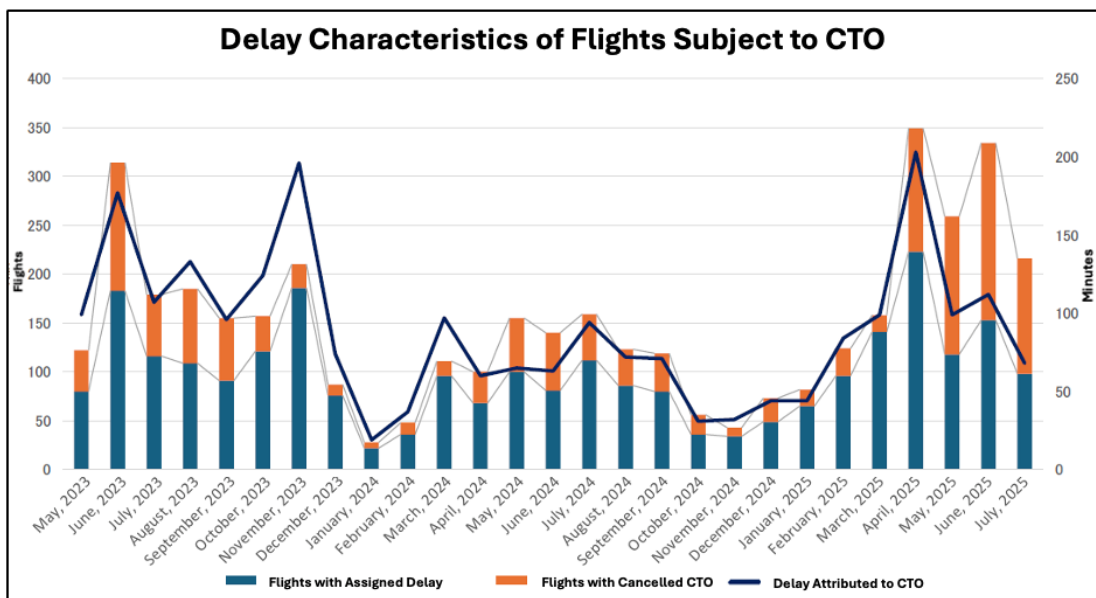


Figure 3 Delay Characteristics of Flights Subject to CTO

2.5 Figure 4 shows the cancellation reasons before and after CTO assignment. Prior to assignment, CTO could not be issued mainly due to limitations in speed compliance, while post-assignment cancellations were observed under various operational conditions, including ATC interventions, weather avoidance, altitude constraints, and updates to ETA.

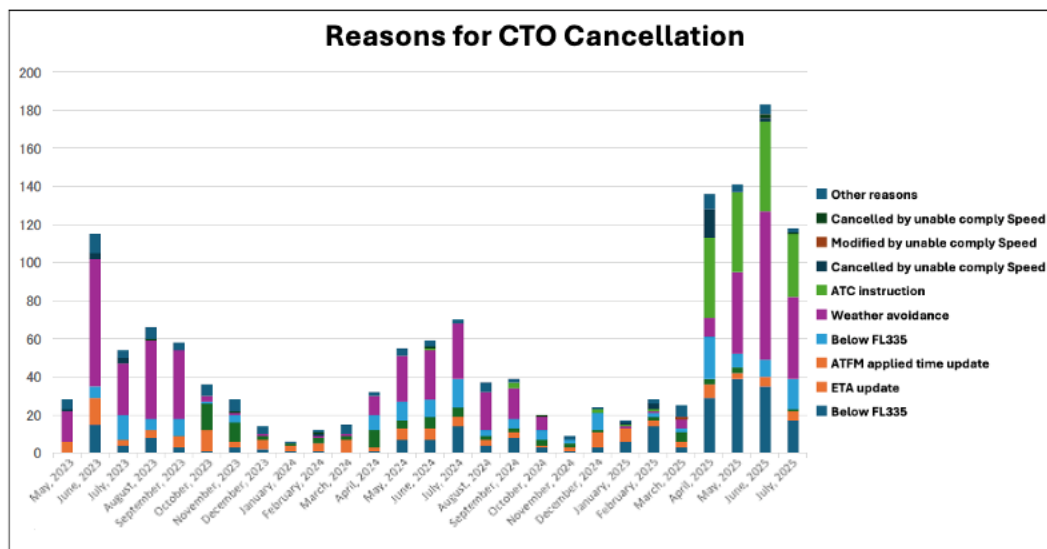


Figure 4 Reasons for CTO Cancellation

ETA Prediction Accuracy and Error Characteristics

2.6 The trial applied speed instructions to meet the assigned CTO. The analysis indicates that, in some cases, differences between assigned CTO and actual passing times were observed. Such differences may be related to:

- aircraft performance and operational conditions;
- weather conditions;
- operational constraints.

2.7 Variations in ETA prediction accuracy were also observed under varying operational conditions, including FIR entry fixes and altitude changes. As shown in Figures 5 and 6, differences between estimated and actual passing times at CTO fixes were observed across different FIR entry fixes and operational conditions.

2.8 As shown in Figure 7, the distribution of ETA prediction errors varies with the time horizon. When adjacent FIR data is incorporated, a reduction in dispersion of prediction errors is observed, particularly at shorter time horizons. This may support improved predictability when such data is available.

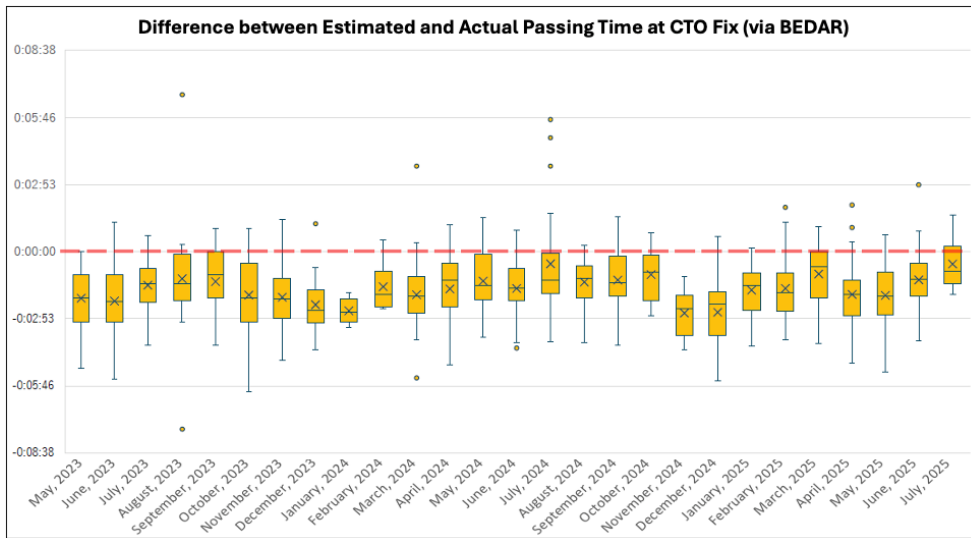


Figure 5 Difference between Estimated and Actual Passing Time at CTO Fix (via BEDAR)

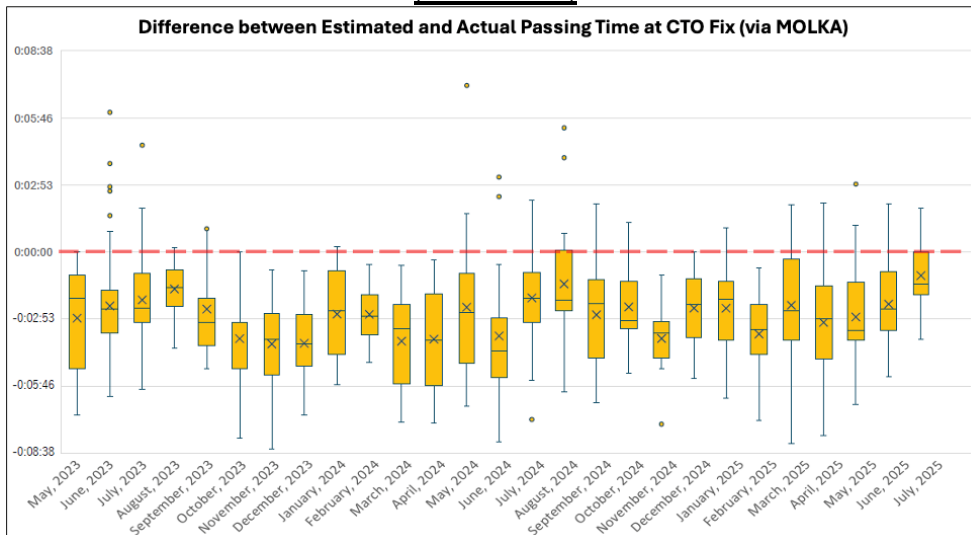


Figure 6 Difference between Estimated and Actual Passing Time at CTO Fix (via MOLKA)

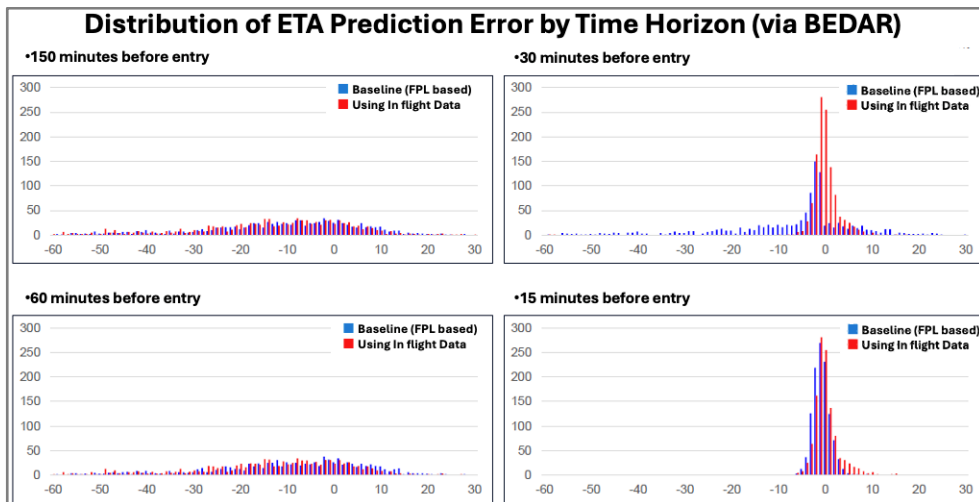


Figure 7 ETA Prediction Error by Time Horizon (via BEDAR)

Operational Interaction and Considerations

2.9 The analysis indicates that the application of CTO was influenced by tactical ATC operations. In situations involving higher traffic complexity, tactical interventions were applied, and assigned CTO were, in some cases, modified or cancelled. CTOT-based flow control for domestic flights arriving at Tokyo International Airport (RJTT) was also in operation during the trial. This reflects the operational interaction between flow management measures and tactical ATC interventions. These observations are considered as part of operational considerations related to CTO application.

2.10 The analysis also indicates that, in environments where traffic flows merge, including international arrival traffic and domestic flights arriving at Tokyo International Airport (RJTT), interactions between different traffic streams were observed. In such situations:

- ATC interventions for maintaining separation were frequently applied;
- cancellations of CTO were also observed.

2.11 Overall, the observations suggest that deviations from planned traffic flow and the resulting tactical adjustments may influence the effectiveness and predictability of CTO application under certain operational conditions. Such interactions may be reflected in the variations observed across Figures 3 to 7.

Summary of Observations

2.12 Based on the observations described in paragraphs 2.1 to 2.11, seasonal variations in CTO cancellations were identified, with a higher number of cancellations observed during certain periods, including the summer season. In addition, the following observations were identified:

- CTO was applied to a portion of flights;
- variations in CTO application were observed under different operational conditions;
- differences between assigned and actual times were observed in some cases;
- variations reflecting tactical ATC operations were observed;
- variations related to deviations from planned traffic flow were also observed.

Conclusions

2.13 Based on the observations described above, seasonal variations in CTO cancellations were identified, with a higher number of cancellations observed during certain periods, including the summer season. These observations may suggest the need for further consideration of CTO application under varying operational environments.

2.14 The results of the trial provide observations on the application of CTO under operational conditions within the Fukuoka FIR. The observations indicate that the application of CTO may be influenced by operational conditions and coordination between ATFM and ATC.

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 matters and operational considerations for CTO application as appropriate

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