International Civil Aviation Organization

SEVENTH MEETING OF THE ASIA/PACIFIC AIR TRAFFIC MANAGEMENT AUTOMATION SYSTEM TASK FORCE (ATMAS TF/7)

Bangkok, Thailand 2-4 June 2026

Agenda Item 4: ATM Automation System Implementation Experience by States

4.6. Development of New Technology

THE RATIONALE FOR REQUIRING PL ALERT DESPITE THE EXISTENCE OF MTCD

(Presented by China)

SUMMARY

This paper presents the PL alert based on Clearance Flight level, which is designed to significantly reduce air proximity incidents induced by altitude level crossing. It elaborates on the functional differences of STCA, MTCD and PL alerts in practical deployment. With statistical data, the paper verifies the application advantages of PL alert, and prospects its development potential in refined air traffic management in the future.

1. INTRODUCTION

1.1 In the ICAO Global Safety Report, vertical loss-of-separation incidents account for 35% of all Loss of Separation (LOS) events, among which approximately 40% are directly triggered by altitude level crossing. In the FAA Near Mid-Air Collision (NMAC) database, vertical insufficient separation incidents caused by altitude level crossing occupy 18% of all NMAC events. Statistics from EUROCONTROL show that about 25% of proximity incidents in RVSM airspace are related to altitude level crossing, which mainly occur when aircraft climb or descend across the flight levels of other aircraft.

1.2 At the 2025 ATM AS-TF6 meeting, China submitted an information paper entitled *Optimization of STCA in Complex Airspace Environment* concerning Short Term Conflict Alert (STCA), in accordance with ICAO ASBU module SNET-B1/1 *Enhanced STCA with aircraft parameters*. On this basis, aiming at near mid-air collision incidents induced by altitude level crossing, this paper proposes the **PL (Predict Collision based on Level Bust)** alert with CFL instruction as the core constraint.

2. DISCUSSION

STCA->MTCD->PL（Predict collision based on Level bust）

2.1 The PL (Predict Collision based on Level Bust) alert is a conflict detection alert oriented to altitude level crossing. Before the controller issues a CFL instruction to aircraft, the system can predict potential conflicts when attempting to assign the target cleared flight level and issue prompt alerts, so as to prevent the release of conflicting CFL instructions in advance. Compared with STCA, PL alert has an earlier safety margin; compared with MTCD, it features higher prediction accuracy.

2.2 Although both STCA and MTCD belong to conflict detection systems, they have essential differences in design philosophy, functional positioning and application scenarios:

Category	MTCD	STCA
Warning Time	4–20 minutes	30–120 seconds
System Positioning	Controller auxiliary tool for proactive planning	Safety net function for pure safety assurance to prevent near mid-air collision
Alert Triggering	Based on trajectory prediction with multiple future possibilities considered	Based on real-time position; triggered when approaching the minimum safe separation
Disposal Mode	Controllers have sufficient time to plan and coordinate resolution measures	Immediate evasive maneuvers are required with high operational pressure
Uncertainty	**Considers trajectory prediction uncertainty and provides probabilistic early warning**	Based on deterministic data with high alert accuracy

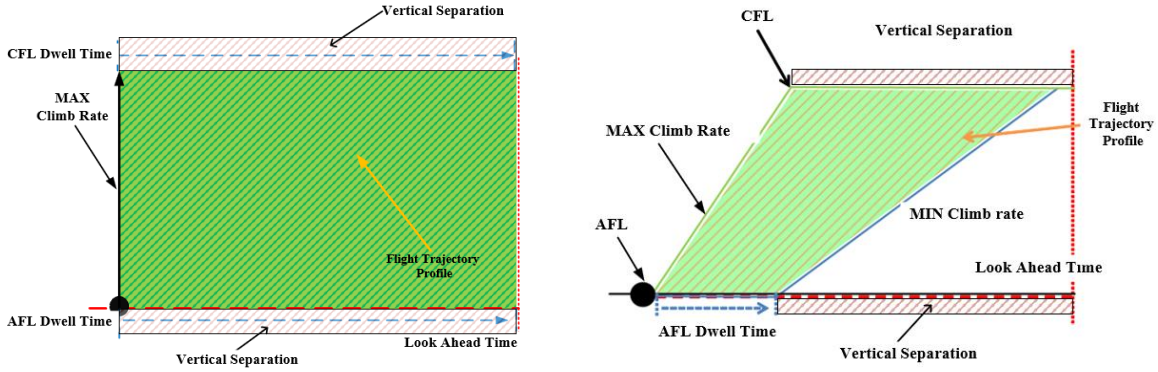
2.3 MTCD (Medium Term Conflict Detection) alert is established on the basis of aircraft 4D flight trajectory. It constructs the vertical flight profile by integrating the current Aircraft Flight Level (AFL), controller-assigned Cleared Flight Level (CFL), sector handover Flight Level (XFL), and Requested Flight Level (RFL). In practical operational deployment, the inherent uncertainty of trajectory prediction leads to a relatively high false alert rate.

2.4 On this foundation, the PL alert adopts a pre-tactical design focusing on controller CFL instructions. The CFL instruction will be officially issued to the crew by the responsible controller of the current sector and will inevitably lead to altitude changes, for which the controller shall take corresponding management responsibility. By weakening the interference of trajectory prediction uncertainty and strengthening the detection capability of controller instructions, the PL alert is developed to reduce near mid-air collision incidents caused by altitude level crossing.

Model of PL Alert

Vertical Model

2.5 The most significant difference of PL compared with MTCD lies in its vertical model, which is highly focused on the CFL flight level and AFL (Actual Flight Level). As shown on the left side of Figure 1, when calculating the flight conflict profile in the vertical airspace, the PL alert adopts the overall vertical airspace occupancy with forward-looking time from the AFL flight level to the CFL flight level.



Vertical Model of PL　　Vertical Model of MTCD

Figure 1

2.6　　As shown on the right side of Figure 1, this is the vertical model of MTCD (without incorporating RFL and XFL factors). Before vertical maneuvering, the occupied airspace is calculated using the maximum and minimum climb rates from the BADA aircraft performance database; after vertical maneuvering, the actual climb rate is adopted for calculation.

2.7　　The design of MTCD may better conform to the logic of aircraft vertical maneuvering. However, operational practice reveals that altitude-crossing missed alerts may occur in airspace not covered by the MTCD vertical profile. The air traffic control operational environment is complex and variable. Track-based conflict detection via STCA has been well-established. Medium-term conflict detection should be instruction-centric rather than trajectory-centric, shifting from in-process detection to preventing the issuance of potential conflict-inducing instructions, and transforming vertical separation management from post-incident response to pre-incident prevention.

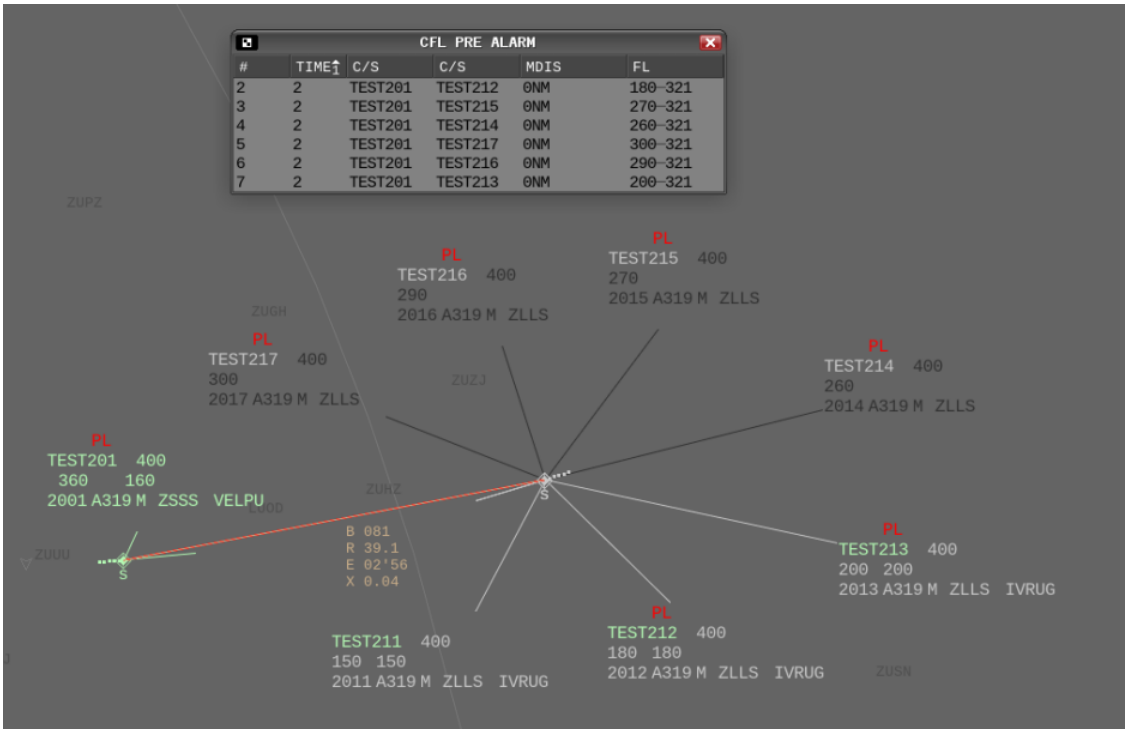
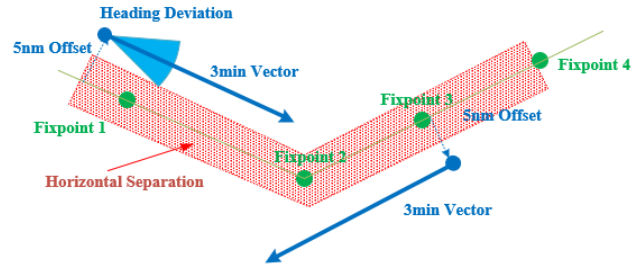


Figure 2　Schematic Diagram of the Vertical Model of PL

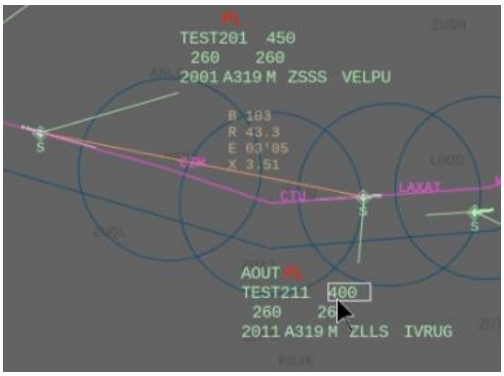
Offset Model

2.8　　The accurate vertical prediction of PL is derived from CFL instructions, while the horizontal prediction comes from the route approved in the FPL (Flight Plan). Whether an aircraft flies

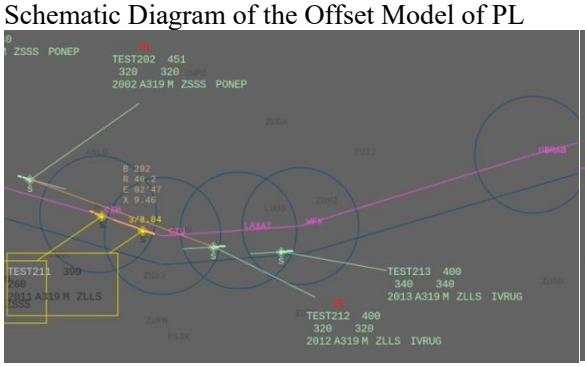
strictly along the route or follows a 3-nm or 5-nm offset procedure along the route, the predictive calculation of PL shall be extrapolated forward based on the route.



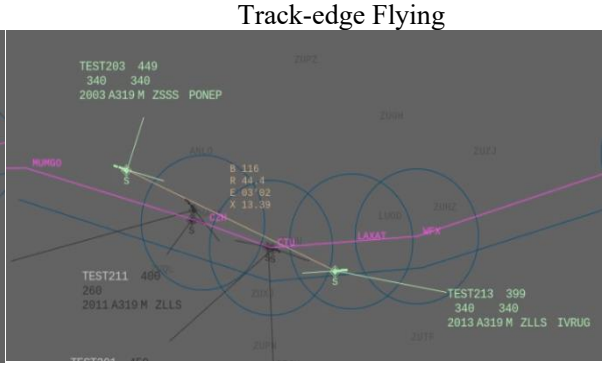
Schematic Diagram of the Offset Model of PL



Track-edge Flying



3nm Offset

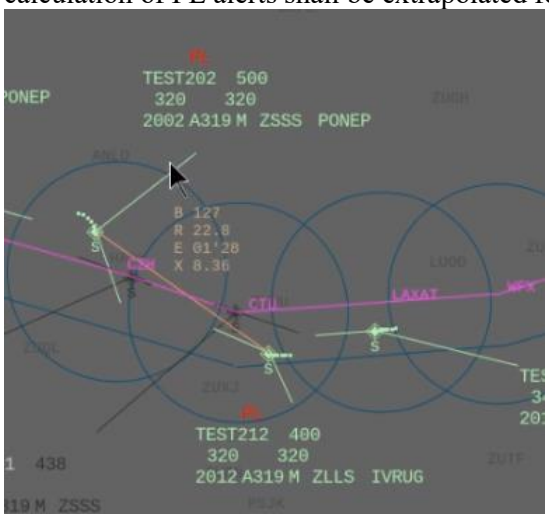


5nm Offset

Figure 3 Offset Model of PL

Track Deviation Model and Holding Model

2.9 When an aircraft enters holding or deviates from the planned route, the horizontal calculation of PL alerts shall be extrapolated forward based on the aircraft's actual heading.



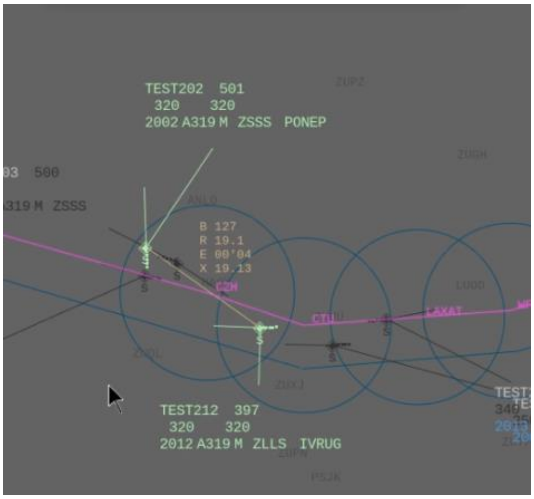


Figure 4 Using the Actual Heading for PL

Application of PL

Case 1: Altitude Conflict Prevention in Chengdu Terminal Control Area

2.10 In December 2025, during the climb phase of a flight, the crew incorrectly set the CFL (Cleared Flight Level) 600 meters lower than the ATC instruction. The PL alert was triggered 78 seconds in advance of STCA. The air traffic controller corrected the instruction in a timely manner, avoiding insufficient vertical separation with an opposite-direction flight operating at 35,000 ft. At that time, the horizontal separation between the two aircraft was only 8 kilometers.

Case 2: Spring Festival Travel Rush Support of Yunnan ATMB

2.11 During the 2025 Spring Festival travel rush, the PL generated a total of 127 valid early warnings and successfully intercepted 39 potential altitude-crossing incidents. It ensured the safe operation of over 1,200 daily flights in Southwest China throughout the travel rush, with no near-miss incidents caused by altitude deviation.

Refined Exploration of PL Alerts in Terminal Areas

2.12 Terminal Areas involve extensive PBN procedures and radar vectoring, which demands higher sensitivity for route-deviation calculations. Meanwhile, terminal areas are subject to frequent stepped descent and climb operations. As shown in Figure 5, during peak flight hours, subsequent aircraft may be instructed to descend before preceding ones reach their designated stepped altitudes. Consequently, the vertical full-airspace occupancy model of PL alerts inevitably generates more false alerts within terminal areas.

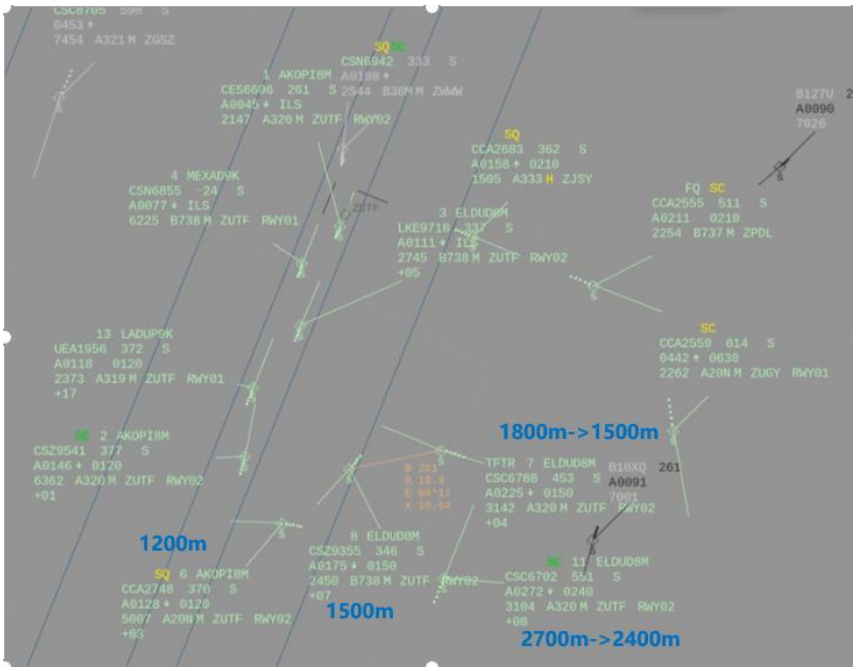


Figure 5 Schematic Diagram of Stepped Descent Flights in Terminal Areas

2.13 Further refined research on PL alerts will be conducted in the terminal area environment, focusing on two key aspects: control operational risks of downwind leg opposite-direction conflicts under dual-runway arrival conditions, and conflicts arising from cross procedures after take-off.

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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