International Civil Aviation Organization

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

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Agenda Item 5: ATMAS integration into SWIM

UPGRADE OF ATM AUTOMATION SYSTEM FOR FF-ICE

(Presented by China)

SUMMARY

With the steady advancement of the global Flight and Flow Information for a Collaborative Environment (FF-ICE), the International Civil Aviation Organization (ICAO) has established the sunset date of FPL2012 flight plans. States have gradually commenced formulating and implementing the deployment for FF-ICE Release 1 (R1). Focusing on the core application requirements of FF-ICE, this paper discusses the core functional upgrade requirements for Air Traffic Management (ATM) Automation Systems to support FF-ICE applications, covering key functional modules including FIXM message reception and processing, flight plan–track correlation, and four-dimensional trajectory profile computation, laying the foundation for subsequent Trajectory-Based Operations (TBO) implementation.

1. INTRODUCTION

1.1 FF-ICE (Flight and Flow Information for a Collaborative Environment) is a core strategic framework proposed by ICAO to restructure the global civil aviation flight information exchange system. Its core objective is to adopt a dynamic, structured and interoperable data exchange mechanism to replace the traditional static, plain-text information exchange mode, so as to accommodate the continuous growth of global air traffic and the practical needs of cross-stakeholder collaborative operations.

1.2 As a longstanding globally adopted traditional flight plan message format, FPL2012 has limited data dimensions and a rigid exchange mode, which can no longer meet the multi-dimensional, real-time and precise information exchange requirements of modern ATM operations. For this reason, ICAO has officially established the regional sunset date of FPL2012 as the end of 2032, the global sunset date as 2034, and the deadline for ceasing amendments to relevant provisions as 2027. The global civil aviation community will transition smoothly to the FF-ICE framework in phases. Release 1 (R1) serves as the initial implementation phase, focusing on the basic application of new information exchange standards, adaptation of core system functions, and pilot operation validation.

1.3 Globally, many regions have launched pilot applications of FIXM, the core data standard for FF-ICE, and some regions have officially commenced regular delivery of FIXM messages to verify the adaptability, stability and operational efficiency of the new messages in real ATM

operational scenarios. However, current mainstream ATM automation systems worldwide are designed and developed based on the traditional FPL2012 message standard. Their system architecture and functional modules lack the structured data processing and multi-source information fusion and parsing capabilities required by the FF-ICE framework, making it difficult to support efficient flow and application of new flight information. To ensure effective reception, parsing, processing and in-depth utilization of various new FF-ICE flight information and fully release the operational efficiency of the FF-ICE framework, targeted research on functional upgrades and adaptive modification of ATM automation systems has become a necessary task for the industry to promote FF-ICE implementation.

2. DISCUSSION

Current Functions and Information Processing Modes of ATM Automation Systems Based on FPL2012

2.1 According to the Doc 9965 <Manual on Flight and Flow Information for a — Collaborative Environment (FF-ICE)>, the present-day flight planning provisions have important limitations: the means for sharing flight plan information between service providers and airspace users relies on multiple two-party message exchanges; flight intent can only be filed up to 120 hours in advance with no long-term notification capability; flight plan messages lack version and sequence information, causing inconsistent data among service providers; information distribution relies on legacy peer-to-peer communications using protocols developed for teletype machines; it has no layered information security for commercial sensitivities or aviation security purposes; reliance on Item 18, fixed field lengths and free text create inefficiency, poor automation processing and inflexible data updating.

Operational Mode Transformation under the FF-ICE Framework and Core Functional Upgrade Requirements for ATM Automation Systems

2.2 Compared with the traditional information exchange mode dominated by FPL2012, FF-ICE brings a fundamental transformation to ATM operations: shifting from fixed text message exchange to structured data exchange, and from single information transmission to full-process collaborative sharing. Based on the System Wide Information Management (SWIM) architecture, FF-ICE adopts standardized data models such as the Flight Information Exchange Model (FIXM) to realize integrated, high-precision exchange of various ATM data including flight plans, tracks, and airspace restriction data, which raises comprehensive upgrade requirements for the information processing, data fusion and precision calculation capabilities of ATM automation systems. In line with the objectives of FF-ICE Release 1 (R1), ATM automation systems need to focus on upgrading three core functional modules to fully adapt to operational requirements.

FIXM Format Message Processing

2.3 As the core flight information exchange standard under the FF-ICE framework, FIXM adopts a structured and extensible data model to replace the plain-text exchange mode of FPL2012 and can carry more comprehensive and refined flight operational data, requiring ATM automation systems to completely reconstruct the message processing module. ATM automation systems shall add a dedicated FIXM message reception interface to achieve standardized connectivity with various ATM information nodes and break the link barriers of traditional message reception; establish a dedicated FIXM parsing module to support splitting, validation and decoding of structured data, compatible with FIXM messages of different versions and scenarios; furthermore, during the FF-ICE transition phase, the system shall support parallel processing of FPL2012 and FIXM messages, realize

bi-directional conversion and concurrent operation of the two formats to ensure stable and uninterrupted ATM operations during system transition.

Flight Plan and Track Correlation

2.4 Under the FF-ICE framework, the information dimensions of flight plans are fully expanded and track data sources become more diversified. The traditional plan–track correlation mode relying on single identifiers can no longer meet operational requirements. ATM automation systems must carry out targeted upgrades to the core flight plan–track correlation module, fully exploit and utilize the refined information carried by new messages to achieve accurate and unique track correlation.

2.5 The upgraded correlation module will no longer rely solely on easily duplicated and confusing identifiers such as transponder code, flight identification and 24-bit aircraft address for matching. Instead, it will adopt the Global Unique Flight Identifier (GUFI) under the FF-ICE framework to achieve uniquely accurate binding between flights and tracks, avoiding correlation deviations caused by identifier conflicts at the source. At the same time, it is equipped with full-process management capabilities including real-time correlation status monitoring, automatic abnormal correlation alerting, rapid error correction and retrospective correction of mismatched data, which can effectively reduce the probability of mis-correlation and missed correlation, significantly improve the accuracy, stability and timeliness of plan–track correlation, and provide controllers with more authentic and reliable air traffic situation awareness.

Four-Dimensional Trajectory Profile Computation

2.6 Four-dimensional trajectory profile computation is the core technical support for FF-ICE to transition to Trajectory-Based Operations (TBO), and also a core function not available in traditional ATM automation systems, serving as the key content of this system upgrade.

2.7 Traditional systems can only perform basic prediction of two-dimensional planar trajectories and approximate times, while the FF-ICE framework requires systems to build a precise four-dimensional trajectory calculation model based on multi-source information such as refined real-time flight data from FIXM messages, aircraft performance data, meteorological information and airspace restriction data, to achieve full-process precise prediction and dynamic correction of aircraft in the four dimensions of longitude, latitude, altitude and time. Meanwhile, it possesses trajectory profile optimization, conflict prediction and collaborative adjustment capabilities, driving ATM operations from passive response to active prediction, improving airspace operational efficiency and flight operational precision, and laying a solid technical foundation for the full implementation of the TBO mode in the future.

CONCLUSION

2.8 The global advancement of FF-ICE and the established sunset and decommissioning schedule of FPL2012 messages drive all-round functional iteration and architecture upgrade of ATM automation systems. As the core information system directly used by controllers in daily operations, its functional adaptability is directly related to the implementation effectiveness of FF-ICE. Among them, the transformation of three core modules including FIXM message processing, accurate flight plan and track correlation based on the Global Unique Flight Identifier (GUFI), and four-dimensional trajectory profile computation is the key to meeting the implementation requirements of FF-ICE Release 1 (R1) and supporting the long-term development needs of Trajectory-Based Operations (TBO).

2.9 At present, mainstream global ATM automation equipment suppliers have not yet launched mature commercial products supporting FIXM data ingestion and integration of other SWIM-compatible formats. Specialized solutions fully adapting to all phases of FF-ICE are still in the stage of research and development, testing and pilot verification, which is also a common technical challenge faced by ATM service providers worldwide.

2.10 In accordance with ICAO's globally unified deployment roadmap for FF-ICE, in addition to the core functional upgrades mentioned above, to fully exploit the value of refined flight information carried by FIXM messages and lay a solid foundation for data sharing and in-depth applications in FF-ICE Release 2 in advance, other supporting functional modules of ATM automation systems need to carry out targeted transformation and adaptive upgrades simultaneously. Meanwhile, ANSPs in the Asia-Pacific region should strengthen collaborative discussions, build consensus, steadily promote the standardized adaptive upgrade of regional ATM automation systems, advance the full integration of systems with the SWIM architecture and compliance with FF-ICE international standards, and make full preparations for the global implementation of Trajectory-Based Operations (TBO).

3. ACTION BY THE MEETING

a) note the information contained in this paper;

b) discuss and develop a regional implementation roadmap, if necessary, regarding the functional upgrade of ATM automation systems to support FIXM applications; and

c) discuss any relevant matters as appropriate.