International Civil Aviation Organization

MIDANPIRG/20 and RASG-MID/10 Meetings

(Muscat, Oman, 14 – 17 May 2023)

Agenda Item 2.2: Update from States and International Organization

OVERVIEW ON EXCHANGE MODELS

(Presented by the United States)

EXECUTIVE SUMMARY

This paper describes the use of information exchange models. The content covers the history of aviation data exchange, and provides information on information exchange models. The paper details the aeronautical, flight, and weather information domains, as well as lessons that the Federal Aviation Administration has collected in the process of conducting demonstrations and validation exercises.

Strategic Objectives:	This information paper relates to Strategic Objective of Air Navigation Capacity and Efficiency
Financial implications:	Not Applicable
References:	None

1. INTRODUCTION

1.1 The exchange of information is a cornerstone of modern aviation. Operations rely on receiving accurate information in the timeframe that it is required.

1.2 Information sharing allows diverse sets of stakeholders to make better decisions in less time. This paper discusses information exchange models, which standardize the way in which data is communicated between organizations and systems.

1.3 The aviation industry has made great strides in the standardization and harmonization of information Exchange Models (XMs), such as the Aeronautical Information Exchange Model (AIXM), International Civil Aviation Organization (ICAO) Meteorological Exchange Model (IWXXM), and Flight Information Exchange Model (FIXM), for the purpose of sharing vital information necessary to its operations. Promoting a standards-based approach furthers achieving System Wide Information Management (SWIM) interoperability for the benefit of the aviation community.

2. DISCUSSION

2.1 Historical Exchange of Aviation Information

2.1.1 Historically, information has been exchanged using message sets generated for each application. Many of the exchanges are not designed for easy and efficient system to system operation, and require time and effort to set up every exchange by each organization. This is not ideal, as new concepts and data elements require manual effort to modify.

2.1.2 Additionally, many systems produce data in custom formats tailored to system-specific needs. As a result, multiple systems may be representing the same flight data, but cannot easily exchange that information without additional translation efforts. This complication can take time and effort to address in situations where each organization uses different elements to show the same data.

2.1.3 As more concepts and data elements are exchanged, it is important that data exchanges promote interoperability. Today's system-specific exchanges are not able to accommodate these advancements.

2.2 Information Exchange Models

2.2.1 The aviation community needs a way to exchange information in a standardized, interoperable format. The solution is to utilize Information Exchange Models. Information XMs serve an important purpose towards enabling interoperability of exchanged information among producers and consumers.

2.2.2 Information Exchange Models are used to standardize the exchange of data elements, organized by information domain. These XMs are currently used to communicate Aeronautical Information, Flight Information, and Weather Information. These domains are covered in the AIXM, FIXM, and IWXXM respectively.

2.2.3 All three of these XMs are standardized data models specified in Extensible Markup Language (XML). They provide a way for systems and services to communicate information in a standardized format. XMs are intended for machine to machine (system to system) communications, not for direct use by a human user. By streamlining the exchange of information, the content is easily convertible into a format that would be displayed to an operator.

2.2.4 The use of XMs provides benefits to implementers and the aviation community. A major benefit is providing interoperability to implementers. By using internationally harmonized core elements in the XMs, users are able to exchange information far more easily, saving time and resources for each new exchange. Interoperability and a common standard also improves access and use of information.

2.2.5 The use of XML in building the XMs also provides benefits to users. XML is a widely used format, which can be used to represent more robust data than previous formats. As an industry standard, many commercial tools and functionalities can be utilized instead of requiring customized tools.

2.2.6 All these functionalities will enable future concepts in aviation. Concepts such as Flight and Flow Information for a Collaborative Environment (FF-ICE[1]) and Trajectory Based Operations (TBO)

[1] ICAO doc 9965, Manual on Flight and Flow – Information for a Collaborative Environment

require seamless exchange of information. XMs will help to enable these concepts by streamlining access to information, promoting interoperability, and representing the data in a rich data format.

2.3 Aeronautical Information

2.3.1 The Aeronautical Information Exchange Model enables the provision in digital format of the aeronautical information that is in the scope of Aeronautical Information Services (AIS). The AIS information/data flows that are increasingly complex and made up of interconnected systems. They involve many actors including multiple suppliers and consumers. There is also a growing need in the global Air Traffic Management (ATM) system for high data quality and for cost efficiency.

2.3.2 In order to meet the requirements of this increasingly automated environment, AIS is moving from the provision of paper products and messages to the collection and provision of digital data. AIXM supports this transition by enabling the collection, verification, dissemination, and transformation of digital aeronautical data throughout the data chain, in particular in the segment that connects AIS with the next intended user.

2.3.3 The AIXM Change Control Board (CCB) maintains and evolves the AIXM Specification as necessary for enabling States to comply with the ICAO global and regional requirements for the provision of aeronautical information, in the context of the evolution towards digital AIM and SWIM.

2.3.4 The AIXM model utilizes a Core and Extension framework to capture both internationally harmonized data and regional specific data needs. The main information areas in the scope of AIXM include: aerodromes/heliports, airspace structures, points, Navaids, procedures, routes, and flying restrictions

2.4 Flight Information

2.4.1 The Flight Information Exchange Model is a global exchange standard capturing Flight information. FIXM is implemented in Unified Modelling Language (UML) and XML and fully supports the data exchange requirements for the FF-ICE concept, as defined by the ICAO Air Traffic Management Requirements and Performance Panel (ATMRPP)

2.4.2 The ICAO FF-ICE concept provides a globally harmonized process for planning and providing consistent flight information. It is guided by the requirement to eliminate or reduce the limitations of the present Flight Plan and to accommodate the future environment detailed in the Global Air Traffic Management Operational Concept[2].

2.4.3 The FIXM CCB provides the governance for FIXM, sets the main principles that guide FIXM development and has overall responsibility for FIXM's evolution. The FIXM CCB is supported by the FIXM CCB Secretariat which provides the technical and human resources for the management of the FIXM Change Proposals, of the FIXM components and of the FIXM online resources.

2.5 Weather Information

2.5.1 The ICAO Meteorological Information Exchange Model is a data format for reporting aviation weather information utilizing Geography Markup Language (GML) and is specified in both XML Schema and Schematron.

[2] ICAO doc 9854, Air Traffic Management Operational Concept

2.5.2 IWXXM includes XML/GML-based representations for products standardized in ICAO Annex III and World Meteorological Organization (WMO) No.49, Vol II, such as METAR/SPECI, TAF, SIGMET, AIRMET, Tropical Cyclone Advisory, Volcanic Ash Advisory and Space Weather Advisory. IWXXM products are used for operational exchanges of meteorological information for use in aviation.

2.5.3 Unlike the traditional forms of the ICAO Annex III / WMO No. 49 products (referred to as Traditional Alphanumeric Codes, or TAC), IWXXM is not intended to be directly used by pilots. IWXXM is designed to be consumed by software acting on behalf of pilots, such as display software. (https://github.com/wmo-im/iwxxm)

2.6 Experience from Demonstrations

2.6.1 The FAA has conducted many demonstrations and validation activities around FF-ICE, TBO, and the use of SWIM for information exchange. These activities include Multi-Regional TBO demonstration, 4DT Live Flight demonstration, and International Interoperability Harmonization and Validation project (IIH&V).

2.6.2 The activities resulted in a number of lessons learned on both future concepts and technical aspects of the demonstrations. In particular, all activities helped to provide experience with use of the information exchange models that facilitated the message exchanges.

2.6.3 The activities found that the exchange models improved the exchange of information by making adoption easier than previous standards. Additionally, the efforts tested that multiple ASPs were able to independently implement the XMs and successfully accomplish the demonstrations. Demonstration partners found that the exchange models were highly beneficial to the validation activities and foundational to the success of the demonstrations. The activities helped to identify potential modification of certain fields to best meet global data needs as well as potential for regional specific extensions.

2.6.4 The outcome of the demonstrations confirmed that the future is moving towards better exchange of information in FF-ICE and TBO, The demos additionally showed that the adoption of exchange models will be key to these concepts and to future communications. The future of interoperability will rely on exchange using the data standards.

2.7 How to Participate

2.7.1 In summary, Information XMs promote interoperability by providing a common way to exchange information. This enables users to pursue future concepts which rely on more efficient exchange of rich information.

2.7.2 The aviation community is encouraged to implement XMs in a collaborative manner. The more users utilizing these models, the greater the benefits that each implementer will experience. Detailed information can be found on each of the XM’s website: FIXM.aero, AIXM.aero, [IWXXM Github]

2.7.3 In addition to implementation, assistance with model development and CCB participation is always welcome.

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