[EN-009] Flight Object –
A Component of Global Air Traffic Management
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Abstract: The Air Traffic Management (ATM) systems are being challenged by significant increases globally in information utilization, management, and information exchanges. The increased availability and sharing of information on a system-wide basis will enable safer and more efficient operations, as well as provide opportunities to realize future capabilities effectively. While the increase in information will occur across the aviation related information groups (such as aeronautical, meteorological, surveillance, infrastructure status, flight specific, and traffic flow management), the focus of this paper is on flight specific information to be managed through the Flight Object.

The Flight Object contains flight specific information and is envisioned as the single common reference for all system information about a flight. It is a collection of common elements that describe an individual flight in terms of its identities, capabilities, preferences and constraints. In today's environment, sharing of the flight information relies on multiple two-party message exchanges. Such message exchange is custom-formatted, and application level data is specific to one task.

FAA message exchange demonstrations have indicated that several benefits are to be realized with the standardization of flight information and availability to all participants through a many-to-many information distribution service.

Keywords: Flight Object, Air Traffic Management, ATM

1. INTRODUCTION

1.1 Background

The Federal Aviation Administration (FAA) is transforming the current National Airspace System (NAS) to a Next Generation (NextGen) modernized ATM system using advanced technologies, software methods, and redesigning the NAS Enterprise Architecture to fully exploit the associated new capabilities.

The existing air transportation infrastructure is not scalable to accommodate the future demand and meet required service expectations. The NAS automated platforms, currently operate as separate entities servicing different flight domains. Each of these domains has specific requirements, technologies, policies, and standards (that may be needed by other domains) in order to move toward the NextGen vision of collaborative and tactical decision making for NAS operations. Similarly, international Air Navigation Service Providers (ANSPs) currently operate as separate entities servicing their own airspace. The technology to allow various types of flight data to be shared among various users and stakeholders does not exist and needs to be developed.

1.2 Problem Statement

Capabilities currently planned for introduction into the NAS for NextGen will require trajectory and other types of flight information. Since it is neither practical nor fiscally sound for each capability to create and store a separate version of the flight information, the FAA and the user community must examine ways to share flight information efficiently.

1.3 Goal

The goal is to develop an International Flight Object data standard to promote data harmonization. Utilizing a common international data standard will increase data consistency, accuracy, and timeliness among the global air traffic management systems.

2. FLIGHT OBJECT OVERVIEW

2.1 Flight Object Description

The Flight Object may be viewed as an "enabler" that promotes flight information sharing among various users and stakeholders by improving system-to-system interoperability. Sharing common information elements improves accuracy and availability of flight information updates, consistency of flight planning among air traffic control automation systems, and

availability of user preferences. The Flight Object is a standard medium for capturing and sharing the most up-to-date information for any flight. The Flight Object is the single common reference for all system information about that flight. Authorized system stakeholders and ANSPs may electronically access the Flight Object to obtain flight data tailored to their specific need, and use. The Flight Object may also be updated to include user changes based on user access rights.

The Flight Object will collect, manage and provide flight-specific data such as, aircraft identification, aircraft parameters, current flight plan information, operator preferences, flight capabilities, and security information (Fig.1). The Flight Object is not envisioned to include non-flight-specific data, such as environment, weather information, or raw surveillance data.
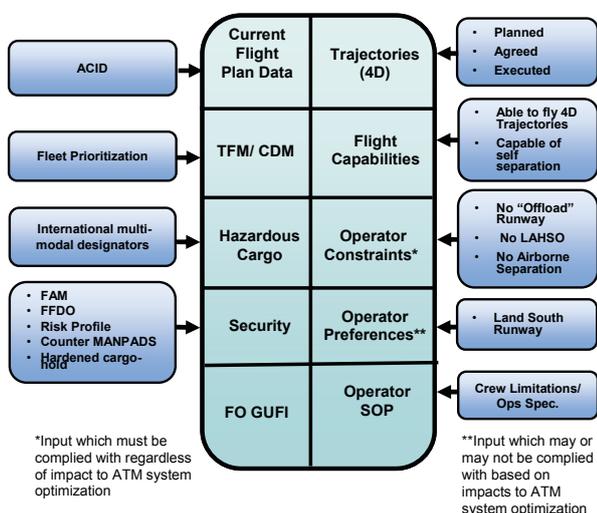

Figure 1 - Flight Object Data Example

2.2 Flight Object Data Exchange

Flight Object data users will use the System Wide Information Management (SWIM) infrastructure and protocols to exchange data. SWIM provides an open and flexible information management architecture that facilitates sharing of operational data (e.g., flight, weather, and aeronautical data) among NAS entities in a secure and manageable fashion [1]. SWIM sits atop the physical, network-level interface capabilities of the FAA's Internet Protocol (IP) Backbone.

SWIM exposes an enterprise level mission service for Flight Object data providers and makes information about that service available to known and potential Flight Object users. Flight Object data consumers can use the SWIM core services to locate and download information about the exposed services. SWIM will provide core services such as interface management, messaging, and security [2]. The Flight Object provides an opportunity for achieving increased operational efficiency by sharing common flight information elements among many different ATM capabilities via a SWIM interface (Fig. 2).
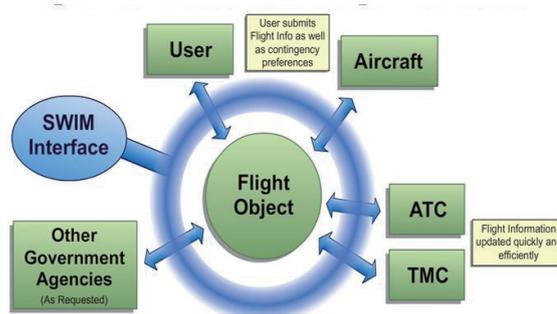

Figure 2 - Flight Information Exchange via SWIM Interface

To facilitate information sharing between Flight Object users, a Flight Object data exchange model will be developed leveraging the Aeronautical Information Exchange Model (AIXM) data standard developed by the FAA and EUROCONTROL [3]. AIXM enables the management and distribution of Aeronautical data, such as Notices to Airmen (NOTAMs), in digital format.

3. INTERNATIONAL FLIGHT OBJECT EFFORTS

3.1 FAA Coordination with ICAO

The FAA is collaborating with other ANSPs through the International Civil Aviation Organization (ICAO). In the development of the Flight Object, the FAA is taking into account the ICAO Flight Plan modifications planned for 2012. The FAA is also participating through ICAO on the Flight and Flow - Information for a Collaborative Environment (FF-ICE) document [4] being generated by the Air Traffic Management Requirements and Performance Panel (ATMRPP).

3.2 FAA Collaboration with Europe

The FAA has been collaborating with EUROCONTROL since 1997 in a series of technical interchange meetings and workshops. In addition, EUROCONTROL has developed a Flight Object Interoperability Proposed Standard (FOIPS) model [5].

3.3 International Flight Object Demonstrations

FAA and Japanese Civil Aviation Bureaus (JCAB) are discussing a Flight Object related joint demonstration in 2011. FAA and Airservices Australia are also engaged in joint collaboration to advance the Flight Object concept. The FAA conducted two Flight Object exchange demonstrations in 2009. The first one was for NAV Portugal's oceanic flight data exchange including 4-D trajectory data and surface flight data exchange involving FAA, National Air Traffic Services (NATS), and an Airspace User [6]. The FAA also conducted a demonstration of airport surface exchange of Flight Object information which included the United Kingdom (UK) [7].

3.3.1 Flight Object Demonstration with Portugal

The International Flight Data Object exchange demonstration with Portugal took place in March 2009. The exchange was between the FAA's oceanic automation system (Advanced Technologies and Oceanic Procedures - ATOP) and NAV Portugal's oceanic system (Sistema Atlântico - SATL). Both systems were modified to send and receive Flight Objects. A SWIM Application Server system was created to link the two Air Traffic Control (ATC) systems together. The sharing of Flight Object data in an oceanic environment allowed flights to follow their preferred business trajectories with minimal controller interaction and simple coordination (Fig. 3). Flight Objects were passed seamlessly between the two international ATC systems, resulting in a successful demonstration.

3.3.1.1 Demonstration Benefits

The demonstration highlighted how the standardization and proliferation of SWIM objects and services can greatly enhance the situational awareness. Exchanging the Flight Object data allowed oceanic automation systems to plan and accommodate the user preference effectively.
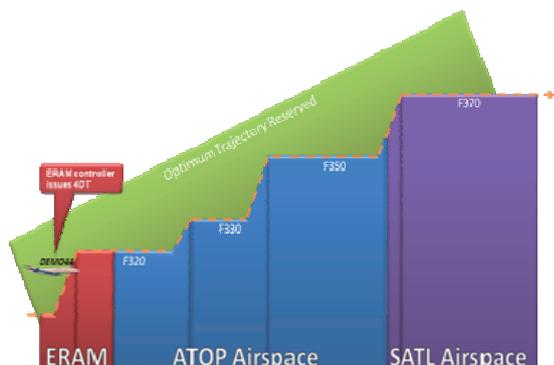

Figure 3 - Flight Object Demonstration between FAA and Portugal

3.3.2 Flight Object Demonstration with United Kingdom

The Surface Exchange Flight Data Object demonstration with the UK took place in November 2009. The demonstration pertained to data sharing between FAA and UK users for a simulated flight originating from London Heathrow (LHR) airport and destined for Daytona Beach (DAB) airport. The demonstration linked the UK NATS's Airport-Collaborative Decision Making (A-CDM) tool to the FAA's Daytona NextGen Test Bed (DBNTB).

Using the A-CDM tool, a request was made to update the Flight Object status due to a delay at LHR. The Flight Object was updated and successfully distributed to the FAA's DBNTB.

3.3.2.1 Demonstration Benefits

The demonstration highlighted the benefits of domestic and international information sharing between Airport operators, ANSPs and Flight Operation Centers. Through the dissemination of real-time flight arrival status, the demonstration showed improved operational efficiency and reduced congestion. The benefits from the demonstrations of shared flight data can easily be transferred to other ANSPs, such as Asia-Pacific air operations.

4. ASIA/PACIFIC FLIGHT DATA INFORMATION EXCHANGE

The US and Europe have introduced ATM modernization programs, such as NextGen and SESAR [8]. Similarly, ANSPs in the Asia/Pacific Region have produced the plans and concepts. For example, Collaborative Actions for Renovation of Air Traffic Systems (CARATS) is JCAB's long-term vision of future Air Traffic Systems. Airservices Australia has been exploring a number of enhancements to its ATC system. All these programs and activities are in line with the ICAO's Global ATM Operational Concept [9]. Fig. 4 illustrates the extent and the density of air traffic operations in the Asia/Pacific region. [10].
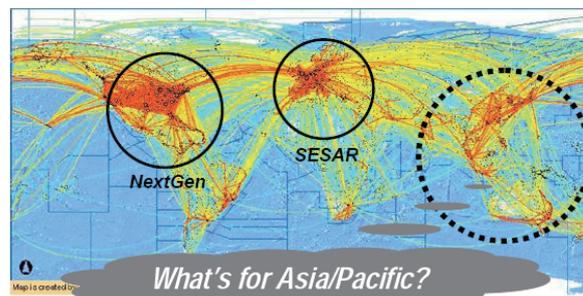

Figure 4 - Global ATM Modernization Planning

This region is divided and consists of 50 Flight Information Regions (FIRs), whose coverage responsibility involves several En-route Monitoring Agencies (EMAs) [11]. Fig. 5 illustrates the geographic coverage of the FIRs.

Figure 5 - Flight Information Regions (FIRs) of the Asia/Pacific

Currently, the FAA's ATOP and JCAB's oceanic systems exchange oceanic flight information using oceanic system point-to-point information exchange methods. As aircraft move between FIRs and EMAs, relevant data, as defined in the EMA Handbook, must be passed among responsible EMAs. The data format required is (human readable) text. Therefore, required fields encompass a broad range of non-standardized flight data. Using a SWIM compliant interface for Flight Object data will eliminate message redundancy and multiple interface issues among the EMAs in the Asia/Pacific region. This SWIM compliant interface will also include user intent and user preferences as well as current flight data. This structured Flight Object data will facilitate the reconstruction of flight history.

Similarly, the FAA's and JCAB's traffic flow management systems will start exchanging messages containing flight data in spring 2011, again using point-to-point information exchange methods. This will be a bidirectional interface for data exchange of filtered data for the relevant flights whose path intersects with US/Japanese airspace. The messages will be formatted in Extensible Markup Language (XML). It is desirable that the point-to-point interfaces will later be replaced by a SWIM-compliant net-centric interface permitting ubiquitous access to the most-current Flight Object data.

The demonstrations of shared flight data, in which the FAA already participated, can be extended to the Asia/Pacific region. Subsequently, this type of partnering activity could provide a migration path for implementing the international standard for Flight Object data.

5. BENEFITS

Sharing standardized common information elements using the Flight Object promotes improved accuracy, availability, and timeliness of flight information updates between the FAA and its global stakeholders. Data accuracy and availability is improved by eliminating the need for serial retransmissions from user to user with the prospect for induced errors at each stage.

Consistency of flight planning across ANSPs will lead to smoother flight transition between regions and increased common situational awareness.

Implementing the Flight Object over the SWIM infrastructure provides for loosely coupled interfaces versus many point-to-point interfaces. In addition, the time needed to establish new interfaces will be reduced. Accelerating information exchange design and development achieves greater efficiency, effectiveness, and lower cost.

6. CONCLUSION

The FAA is seeking collaboration from interested international organizations in an effort to harmonize development of a global Flight Object data standard.

International collaboration elicits more efficient and expansive information sharing between ANSPs, more cost effective development and deployment of the Flight Object capability, and better quality decision making (as a result of more timely, accurate, and complete information).

The FAA will hold a series of workshops to promote understanding of the Flight Object concept and to provide an avenue to participate in the standardization of flight data.

7. ACKNOWLEDGEMENTS

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9.   COPYRIGHT STATEMENT