Request for Information (RFI)
for
Guidance on AAtS Standards Harmonization

RFI Issuance Date: 23 September 2013

Response Due Date: 15 October 2013

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ABSTRACT

The FAA's Aircraft Access to System Wide Information Management (AAtS) initiative is in its evolutionary stages of requirements development and standards identification. Its goal is to provide aircraft connectivity to the FAA's SWIM infrastructure to communicate/share aviation data and services. This connectivity will establish a common operating environment between the flight deck, air traffic management and Airline Operational Control/Flight Operational Control (AOC/FOC) for collaborative strategic decision-making. Distribution of the operational information needed to support the safe movement of aircraft during all phases of flight in the National Airspace System (NAS) will increase capacity, efficiency, and result in more timely departures and arrivals.

There are a number of aviation standards in development, concurrently and independently, by a variety of industry groups that are also pursuing the development of requirements and standards to leverage ground-based aviation related information and data networking technology to support the operation of aircraft. The need to understand the scope, applicability and relationship between these efforts is both critical and timely.

This Request for Information (RFI) is part of an initiative sponsored by the FAA to engage the community in identifying the relevant standards efforts, analyzing the differences, overlaps, gaps, and conflicts across the efforts, and to drafting a recommendation for a harmonized architecture guidance that can be further prototyped and tested in a future effort.

Readers of this RFI are encouraged to respond with comments on the initial work of this topic and offer insights into harmonized architectures, standards and resulting requirements. Responses to this RFI should include identification of relevant standards and where they fit within potential harmonized architectures.

Responses provided will guide the discussion at a community workshop, scheduled for 5-6 November 2013 in Washington DC (details to be made available at the webinar or shortly thereafter), and will be considered in the development of a report that will form the basis for harmonization guidance and recommendations.

Responses to the RFI are requested by 15 October 2013. Included herein are instructions for how organizations can respond and how to get responses to any question about the RFI. A public Q&A webinar is scheduled for 1 October 2013 to provide the community with more information on the context and objectives behind this RFI.

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1   Introduction

1.1   RFI Purpose and Scope

This Request for Information (RFI) is intended to engage the community in identifying standards efforts relevant to the provision of aircraft connectivity to the FAA's SWIM infrastructure to communicate/share aviation data and services, as planned in the FAA's Aircraft Access to System Wide Information Management (AAtS) initiative.

Organizations interested in responding to this RFI are encouraged to participate and contribute information on:

- Technologies, standards and general trends relevant to AAtS
- Practical recommendations on harmonization opportunities and challenges
- Insights on how to best craft an interim path for the community and to develop a technical architecture that is forward thinking and can accommodate this emerging and evolving environment.
- Global harmonization considerations

Information provided in the RFI responses will guide the discussion at a community workshop scheduled for 5-6 November 2013 in Washington DC, and will be taken into account in a report that will serve as the basis for harmonization guidance and recommendations. The Findings Report will be available to all participants, supporting organizations and sponsor. After the next OGC Technical Committee (TC), it will be made publicly available to all.

1.2   Organization issuing this RFI

The Open Geospatial Consortium (OGC, http://www.opengeospatial.org) is an international consortium of more than 480 companies, government agencies, research organizations, and universities participating in a consensus process to develop publicly available geospatial standards. OGC standards support interoperable solutions that "geo-enable" the Web, wireless and location-based services, and mainstream IT. OGC standards empower technology developers to make geospatial information and services accessible and useful with any application that needs to be geospatially enabled.

1.2.1   Supporting Organizations

This RFI is issued by the OGC Interoperability Program (http://www.opengeospatial.org/ogc/programs/ip) based upon interest and contributions from the FAA AAtS initiative, the RTCA Special Committee 206, and the AGIE ARINC subcommittee.

The FAA's Aircraft Access to System Wide Information Management (AAtS) initiative, currently in its evolutionary stages of requirements and standards identification, aims to provide aircraft connectivity to the FAA's SWIM infrastructure to communicate/share aviation data and services. This connectivity will establish a common operating environment between the flight deck, air traffic management, and AOC/FOC for collaborative strategic decision-making.

The RTCA Special Committee (SC) 206 (http://www.rtca.org) has developed technology agnostic concepts, architectures, and requirement standards to define Aeronautical Information Services (AIS) and Meteorological (MET) Data Link Services to and from aircraft in support of future air traffic management concepts. SC-206's work is ongoing and future work is expected to progress into greater decomposition, detail and technical specifications.

The AGIE ARINC subcommittee (http://www.arinc.com) leads ARINC Project Paper 830 - Aircraft/Ground Information Exchange, establishing a standard for a non-proprietary application level information interchange framework. This includes protocols, functions, and interfaces that enable application-to-application information exchange between aircraft and ground applications in a universal manner.

2 Context

The FAA's Aircraft Access to System Wide Information Management (AAtS) initiative is in its evolutionary stages of requirements and standards development. Its goal is to provide aircraft connectivity to the FAA's SWIM infrastructure to communicate/share aviation data and services. This connectivity will establish a common operating environment between the flight deck, air traffic management, and AOC/FOC for collaborative strategic decision-making. Distribution of the vast amount of operational information (such as AI, MET, and ATM) is needed to support the safe movement of aircraft during all phases of flight in the National Airspace System (NAS). This information sharing will lead to increased capacity, efficiency, and result in more timely departures and arrivals.

2.1 Description of FAA's Aircraft Access to SWIM

There are several elements to be considered in describing Aircraft Access to SWIM (AAtS). The first element is a general understanding of AAtS as connecting ground-side networked ANSP (FAA for AAtS) derived information to the aircraft and flight crew in an emerging capability required for efficient aircraft operation and collaborative decision making between the air traffic controllers, dispatchers, and flight crew.

While all of the standards with regard to global implementation of this capability are worthy of harmonization, the current effort is specifically focused on the FAA AAtS.

The second element is where AAtS fits within the broader discussion of air-ground ATC/ATM data link services. AAtS functionality is one element of the evolving solution for ATS/ATC and ATM communications between the ground-based NAS services and the aircraft, flight crew, and AOC/FOC. Air traffic management systems communicate with aircraft and flight crews via existing aviation communication links. Aircraft trajectory control is currently via voice; however, in the evolving NextGen environment this will increasingly be handled by approved aviation data links, i.e., data communications (DataComm). SWIM provides communication mechanisms and information services that allow the aircraft operator (AOC/FOC) to share information with NAS services. Aircraft operators (AOC/FOC) communicate with the aircraft via commercial AOC data links, such as ACARS. AOC data shares data link and onboard computing resources with ATS data. The FAA AAtS initiative does not get involved in these aspects of the ATM solution space.

As shown in Figure 1, central to the FAA AAtS initiative is an industry implemented Data Management Service (DMS). The DMS provides a bi-directional information exchange capability between NAS services via SWIM and onboard systems using commercial data links. AAtS includes a portal to the AOC/FOC to facilitate service management for configuring and monitoring the DMS. Although SWIM-AOC/FOC and SWIM-SWIM interactions (i.e., FAA-SWIM to Euro-SWIM) are not within the scope of the FAA AAtS initiative, they are still key elements of the overall solution, and hence they can be considered part of harmonization.
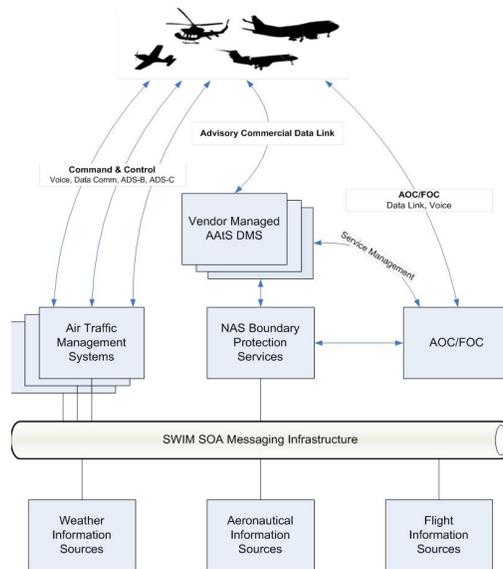
Figure 1 FAA AAtS Logical Relationships Diagram

2.2   The plan for Standards Harmonization for AAtS

There are a number of aviation standards being developed, concurrently and independently, by a variety of industry groups and committees (i.e., RTCA Special Committee 206 (SC-206), Aircraft/Ground Information Exchange (AGIE), and Open Geospatial Consortium (OGC) standards) that are pursuing the development of requirements and standards to support and leverage ground based aviation related information and data networking technology to support the operation of aircraft.

The FAA and industry are moving towards consensus that electronic distribution of operational data and technical information will increase NAS/airline productivity and efficiency and deliver a more positive passenger experience both domestically and internationally. With that comes the need to identify harmonization opportunities across these efforts (in addition to others, as requested in this RFI) since the aforementioned aviation committees also represent global interests.

The first phase is to identify the areas of overlaps/differences/conflicts/interactions in the standards efforts undertaken by SC-206, AGIE and OGC (as well as others identified by the community in response to this RFI), and to set a framework for recommending, developing, and testing a harmonized architecture between relevant concepts, requirements and standards. This phase involves, but is not limited to:

- Reviewing standards from each activity to identify major coordination and harmonization focus areas with a focus on technical architecture, use cases, interactions and gaps.

- Engaging the community for input on harmonization opportunities, gaps and on-going/related work.

- Capturing harmonization guidance and potential harmonization architectures in a technical report.

The second phase involves scoping and executing an agile prototyping activity to test and validate the guidance of phase 1, based on the OGC IP policies and procedures (http://www.opengeospatial.org/ogc/policies/ippp). This step involves, but is not limited to:

- Identifying appropriate short-term activities (e.g., prototype implementations, demonstrations and interoperability experiments) to test/close a subset of harmonization gaps.

- Issuing a Request for Quotations (RFQ)/Call for Participation (CFP) to solicit community contributions.

- Capturing community prototyping and validation outcomes, and documenting recommended standards inputs and/or considerations.

3   Relevant Standards Efforts Identified to-date

In planning for this RFI, the issuing organizations have identified the following standards activities as relevant to the goals of the project:

- FAA AAtS documents. These documents provide the baseline understanding of operational usage, technical requirements, and rationale for AAtS. These include: *AAtS Implementation Guidance Document v2.0* dated 1 March 2013, *AAtS Concept of Operations v1.0* dated 31 July 2013, and *AAtS Full Data Exchange Technical Concept Paper v1.0* dated 31 July 2013.
- RTCA SC-206 activities, responsible for the definition of AIS and MET data link services that are envisioned to be implemented within the next decade in both the United States and Europe. The committee is charged with providing the concepts, architecture and safety and performance requirements for aeronautical and meteorological data link services for pilot decision support and Collaborative Decision Making (CDM) between ground services, the flight deck, Air Traffic Control (ATC) and, as appropriate, Airline Operations Centers (AOCs) in all flight environments for flight efficiency and/or hazard avoidance.
- AGIE, a standard for a non-proprietary application level information interchange framework that includes protocols, functions, and interfaces that enable application-to-application information exchange between aircraft and ground applications in a universal manner. AGIE is particularly applicable to Data Loading Systems, Electronic Flight Bags (EFB), In-Flight Entertainment (IFE), Flight Operations Quality Assurance (FOQA), IP enabled avionics and cabin systems, RTCA SC-206 and Aircraft Access to SWIM.
- OGC standards and best practices, including OGC information models such as the Geography Markup Language (GML) which forms the basis of modern information exchange models within the Aviation domain, such as AIXM and WXXM; OGC services applicable to the run-time discovery and on-demand access, dissemination and integration of AIS, Met, Flight Object information, and event-based information (such as Digital NOTAMs); and security mechanisms enabling fine-grained (service-based) access to information, so that users can only access and modify the information they are allowed to.

For more detailed information about each of the above identified relevant efforts:

- Refer to Section 5 of this RFI;
- Register for the public information webinar to be held on 1 October 2013 (Details available at https://www4.gotomeeting.com/register/198363519)

One of the objectives of this harmonization guidance effort is to develop a framework where the above activities (and others as identified in the RFI responses) fit within the AAtS concept. Such a framework would provide an easy-to-use and visible mechanism for showing which standards are applicable at which layers (e.g., network, messaging, application services, data definition, user applications, etc.) and facilitate the analysis of standards activities overlap, conflicts, relationships, etc. Recommendations for an easy-to-use, flexible and extensible analysis framework are welcome in the RFI responses.

4   Responding to this RFI

4.1   General terms and conditions

Responses to this RFI are due by the date listed in the Master Schedule. Responses will be distributed to representatives of the issuing organizations listed in section 1.2. Submissions will remain in the control of this group and will be used only for the purposes identified in this RFI. A summary of the RFI responses may be made public. **DO NOT include ANY proprietary information in your submission.**

4.2   How to submit a response

Send your response in electronic version to the OGC Technology Desk (techdesk@opengeospatial.org) by the submission deadline. Microsoft® Word format (Office Version 2003) is preferred, however, WordPerfect®, Rich Text Format, or Adobe Portable Document Format® (PDF) are acceptable.

You are welcome to contact the OGC Technology Office via telephone (+1 812 334 0601) to ensure receipt of your submission.

4.3   RFI response outline

Your RFI response should follow the outline listed below. Your response should consider the questions listed as well as providing any additional information your organization considers as relevant to the objectives of the harmonization guidance effort. In order to remain within the scope of this RFI, responses are encouraged to be concise and focused on data exchange, services, and applications issues; and not focused on hardware, networking, security solutions, and information modeling activities.

1. Overview and executive summary
    a.   Provide a summary of the most important elements of your response
2. Organization Description
    a.   Type of organization (data provider, EFB provider, infrastructure provider, ANSP, DMS provider, etc.)
3. Elaboration
    a.   What technologies/standards do you use or plan to use that you believe are relevant to AAtS?
    b.   Which areas do you recommend for harmonization? Can you identify harmonization opportunities AND challenges?
    c.   Based on your position in the market, what suggestions can you offer to identify priorities and establish a direction for leveraging technologies/standards in developing the harmonization guidance effort?

4.4   Questions and clarifications

Questions and requests for clarification should be sent to (techdesk@opengeospatial.org) **prior to the public webinar**.

Questions received as well as clarifications from the issuing organizations will be posted publicly at the Guidance for AAtS Standards Harmonization RFI web site:
http://www.opengeospatial.org/standards/requests/111

A public information webinar is scheduled for the date shown in the Master Schedule. To register for this webinar, use this link https://www4.gotomeeting.com/register/198363519

For those who are unable to attend the call, we will post a summary of the questions and clarifications addressed during the webinar call shortly thereafter.

4.5   Reimbursements

The organizations issuing this RFI will not reimburse submitters for any costs incurred in connection with preparing responses to this RFI.

4.6   Master schedule

Activity/Milestone	Date
RFI Issued	23 September 2013

Public information webinar	1 October 2013
RFI Responses Due	15 October 2013 – 5:00 pm EDT
Workshop (Washington DC)	5-6 November 2013
Findings Report	31 December 2013

The Findings Report will be available to all participants, supporting organizations and sponsor. After the next OGC Technical Committee (TC), it will be made publicly available to all.

As described in Section 2.2, there will be a follow-on prototyping phase upon successful completion of the activities listed in the Master Schedule above.

5   Appendices

5.1   AAtS Documents

5.1.1   AAtS Implementation Guidance Document (IGD) v2.0 dated 1 March 2013

The AAtS Implementation Guidance Document v2.0 is intended to inform and support FAA guidance and industry implementation of AAtS concepts to include, but not be limited to, identifying and specifying:

- External user guidance to connect aircraft to SWIM and interact with NAS services
- Expectations, options, and examples on functional behavior and capabilities for the purpose of developing guidance to external users and the regulators of AAtS
- Requisite interaction with other members of the decision-making community including other agencies, air navigation service providers (ANSPs), and airspace users
- Potential changes to FAA regulations and guidance documentation

The primary users of this document are those who will be responsible for granting operational approval for the implementations of the SWIM based data exchange of information to aircraft. Additionally, this document is intended to provide initial background information to various industry stakeholders. Potential stakeholders include, but are not limited to:

- FAA Office of Aviation Safety (AVS)
- Data Management Service (DMS) providers who will develop the requisite network connections and functional interface to SWIM to consume NAS Services on behalf of aircraft operators
- Aircraft operators that intend to consume NAS services for use in aircraft

The AAtS Implementation Guidance Document also describes the concepts, functionality, and behavior of systems necessary to implement an interoperable AAtS capability to include, but not be limited to:

- Describing how government agencies and commercial entities interact and do business, including rules of engagement, interagency agreements, policies, interconnection and data sharing agreements, and business rules
- Establishing the network connection, obtaining access, including access policies, controls, and permissions
- Establishing the service connections, obtaining access, and how to discover those services

- Describing the information exchanges associated with the data, message timeliness, occurrence of lost messages, and statistical information on the occurrence of errors being captured and reported to end users

However, it must be noted that the AAtS IGD v2.0 delineates a one-way data exchange concept of information from NAS services via SWIM to the onboard aircraft systems using commercial data links. An AAtS IGD v3.0 is in development and nearing completion which expands the concept to address a bi-directional data information exchange capability between NAS services via SWIM and onboard aircraft systems using commercial data links. This next version addresses and is consistent with the *AAtS Concept of Operations v1.0* dated 31 July 2013 and the *AAtS Full Data Exchange Technical Concepts Paper v1.0* dated 31 July 2013.

5.1.2   AAtS Concept of Operations v1.0 dated 31 July 2013

This Aircraft Access to SWIM (AAtS) Concept of Operations (ConOps) document builds on the Concept of Use (ConUse) document developed in fiscal year 2012. The ConUse focused on the uplink of tailored, on-demand, digital National Airspace System (NAS) information to flight crews through authorized service providers using an interface to a common infrastructure – System Wide Information Management (SWIM). This document re-iterates this concept, while incorporating the next phase focusing on the downlink of relevant data from the aircraft and flight crews to stakeholders internal and external to the Federal Aviation Administration (FAA).

5.1.3   AAtS Full Data Exchange Technical Concepts Paper v1.0 dated 31 July 2013

The AAtS Full Data Exchange Technical Concept Paper is derived from the draft *AAtS Concept of Operations* document of June 2013 which subsequently became final and dated 31 July 2013. This paper expands upon the uplink technical concepts described in the *AAtS Implementation Guidance Document* v2.0 of 31 July 2013 and focuses on developing the complementary downlink technical concepts to enable aircraft to publish aircraft derived data to the FAA's National Airspace System (NAS) System Wide Information Management (SWIM) infrastructure in a globally interoperable manner. Notional interoperability includes not only the FAA SWIM infrastructure, but also the Single European Sky ATM Research (SESAR) SWIM, Japanese Civil Aviation Bureau (JCAB) SWIM, Civil Aviation Authority of China (CAAC) SWIM, and other potential SWIMs.

5.2   Overview of RTCA SC 206 Activities

A key objective of the future International Civil Aviation Organization (ICAO) Air Traffic Management (ATM) concept and Next Generation Air Transportation System (NextGen) performance based capabilities is to establish the aircraft as a primary participant in collaborative decision making (CDM); and, in some cases, establish airspace regions for autonomous operations where the aircraft is primarily responsible for safe separation from other traffic, weather and designated/restricted airspace. Timely availability of high-quality and reliable electronic Aeronautical Information Services (AIS) and Meteorological Information Services (MET) are necessary to support the transition and implementation of these advanced global ATM concepts envisioned by ICAO, NextGen, and Single European Sky ATM Research (SESAR).

As a private, not-for-profit corporation, RTCA is used as a Federal advisory committee to develop comprehensive, industry-vetted and endorsed recommendations for the government and industry on issues ranging from technical performance standards to operational concepts for air transportation. RTCA Special Committee (SC) 206 *Aeronautical Information Services (AIS) and Meteorological (MET) Data Link Services* is charged with developing concepts and technical standards for invocation by the regulatory arm of the FAA and for industry use as it relates to the data link service delivery of AIS and MET information.

5.2.1   Description

RTCA SC-206 was established in February 2005 at the request of the Federal Aviation Administration (FAA) Associate Administrator for Safety. Since then, SC-206 has conceptually described the future environment that these data link services will operate, the concepts that AIS and MET data link services will be used, and the safety and performance requirements that some of these services must perform. These descriptions, while enabled by technology, are not technology specific and have been, to this point,

agnostic of any specific implementations. For the first two standards listed below, this SC worked in conjunction with EUROCAE WG-76.

As of the release of this Request for Information (RFI), current standards developed by SC-206 are:

- **DO-308** -   This Operational Service and Environment Definition (OSED) presents the AIS and MET data link services that are envisioned to be implemented within the next decade in both the United States and Europe. The OSED also includes assumptions about the environment in which these services will operate. These services will provide the aeronautical information for pilot decision support and Collaborative Decision Making (CDM) between ground services, the flight deck, Air Traffic Control (ATC) and, as appropriate, Airline Operations Centers (AOCs) in all flight environments for flight efficiency and/or hazard avoidance.

- **DO-324 -**   This Safety and Performance Requirements (SPR) specifies minimal baseline operational requirements for the data link delivery of AIS and MET information as the primary means of communications between air and ground. The operational and safety performance requirements were assessed based on a notional systems architecture and need to be validated before being implemented by any candidate data link system.

- **DO-339 -**   This OSED defines a concept of operations for transmitting aircraft-derived meteorological data to enable a wide range of Next Generation Air Transportation System (NextGen) and Single European Sky ATM Research (SESAR) applications. The OSED also describes a number of wake turbulence, air traffic management, and meteorological applications that can benefit from the downlink and crosslink of these aircraft-derived data.

- **DO-340 -**   This Concept of Use document provides an aviation industry view on how AIS and MET data link services would be used to support flight operations. It describes system concepts and user applications for using data link services for communicating AIS and MET information to and from aircraft. The data link services are considered as either a primary (Category 1) or useful (Category 2) means for communicating AIS and MET information. Category 1 services would be capable of supporting specific air traffic operations and would meet specific safety and performance requirements. The implementation of such services will be evolutionary beginning with the initial and expected widespread use of useful (Category 2) AIS and MET data link services.

5.2.2   AIS and MET Services
In each of the standards, the evolving AIS and MET data link service delivery architecture is outlined. Throughout this evolution, several constants are described. There are three main functional components of these services:

- Ground based functionality – this has developed into a functional term known as the Ground Data Link Processor Function (GDLPF). The GDLPF contains functions that range from the network layer through to the application layer. It should be noted that the scope of the GDLPF does not include software application level processing and computation (e.g., ingesting disparate MET sensor readings into a computational model and creating a forecast output), but it does include the intelligence to manage and filter data to support application level processing and computation. Some high level functions of the GDLPF include:

    o Retrieving data and information from sources and databases
    o Validating the retrieved data/information
    o Preparing the validated data/information for transmission (i.e., any protocol translations required, message assembly, and compression)
    o Message brokering, routing and prioritization
    o Data Link Network Management

- Data Link Connectivity – this remains an agnostic functional representation of the connection to the aircraft from the data link layer down. Depending on the allocation of functions, this may or may not include some overlap into the network layer.

- On aircraft functionality – this has developed into a functional term known as the Onboard Data Link Processor Function (ODLPF). The ODLPF contains similar functions as the GDLPF with a similar range; however, with notable contextual differences based on the environment it operates in (i.e., onboard the aircraft). Some of the high level functions of the ODLPF include:

  o Processing information requests
  o Storing and retrieving information from onboard sensors/databases and ground sources
  o Validating the received data
  o Updating the onboard databases
  o Preparing the validated data/information for transmission (i.e., any protocol translations required, message assembly, and compression)
  o Message brokering, routing and prioritization
  o Data Link Network Management

These functions have been developed to support six services (five from DO-340 and six with the inclusion of the DO-339 service). These services are:

- **Baseline Synchronization Service (D-BSS) -** This service updates the onboard database(s)

- **Aeronautical Update Service (D-AUS) –** This service provides permanent & temporary changes applicable to a flight; independent of the stored databases onboard the aircraft.

- **Weather Planning Decision Service (D-WPDS) –** This service provides updates of weather information to support pilot planning decisions affecting flight operations beyond a 20 minute time horizon.

- **Weather Near Term Decision Service (D-WNDS) –** This service provides updates of weather information to support pilot near term decisions affecting flight operations within the next 3-20 minutes.

- **Weather Immediate Decision Service (D-WIDS) –** This service provides updates of weather information to support pilot immediate decisions affecting flight operations within the next 1-3 minutes.

- **Aircraft Derived MET Data Service –** This service disseminates data that supports a wide range of future applications in the areas of wake turbulence, air traffic management, MET situational awareness and MET forecasting.

5.2.3   Standards in Development

Currently, there are two documents under development which further refine and extend the services and functions mentioned in section 2. The first (*AIS and MET Services Delivery Architecture Recommendations*) is nearing completion and by the dissemination of this RFI should be in the process of release for its final review by the aviation industry. The other (*Minimum Aviation System Performance Standards (MASPS) for AIS and MET Services*) is in the early drafting stages and is not scheduled for publication until September of 2014, with a possible extension being considered for March 2015.

5.3   Overview of AGIE

ARINC Project Paper 830: *Aircraft/Ground Information Exchange (AGIE)* establishes a standard for a non-proprietary application level information interchange framework. This includes protocols, functions, and interfaces that enable application-to-application information exchange between aircraft and ground applications in a universal manner. While at the AGIE layer all communications occur over IP, the standard does not stipulate lower layer communication technologies and is air-ground link agnostic. This

information interchange capability defines on an always available, common, and non-proprietary information exchange framework to allow the operator to centrally manage cost, performance and quality of service, and reduce equipment footprint.

Examples of systems that are in need of such an infrastructure include: Data Loading Systems, Electronic Flight Bags (EFB), In-Flight Entertainment (IFE), Flight Operations Quality Assurance (FOQA), IP enabled avionics and cabin systems, RTCA SC-206 and Aircraft Access to SWIM.

5.3.1   Description

The AGIE standard provides a unique end-to-end capability and supports link agnostic cross domain services, e.g., the Aircraft Control Domain (ACD), Airline Information Services Domain (AIS) and Passenger Information and Entertainment (PIES) Domain and is intended to function over any air-to-ground link. These domains are defined in **ARINC Specification 664 Part 5:** *Network Domain Characteristics and Interconnection*. AGIE intentionally excludes the Passenger Operated Devices Domain (PODS), but provides features and capabilities that allow operation across and segregation between these three domains.

AGIE's end-to-end capability is unique in that it specifies air and ground aspects in addition to client-to-client and application-to-application. Additionally, the AGIE standard provides operator prioritization and queuing features to allow optimization of message traffic on data links and message queue management. As a result, the operator is able to manage data link cost, performance and Quality of Service (QoS).

AGIE leverages transport layer services offered by the Advanced Message Queuing Protocol Version 1.0 (AMQP). As the AMQP matures, AGIE will expand its usage of built-in AMQP features beyond just transport services.

5.3.2   AGIE Services

AGIE defines a communication infrastructure through which any end-system application (aircraft or ground-based) can submit data into the AGIE data network for the purpose of having this data being automatically transported and made available for retrieval by the intended recipient end-system (also either aircraft or ground-based) application. Operationally, this is analogous to a person depositing a letter in a mail box with the expectation that this letter is subsequently delivered by the postal service to a mail box from which the addressee will retrieve this letter at some later time.

The AGIE standard defines data exchange to be between end-systems/applications and to be sent as messages. The following delivery methods are provided:

- Point-to-point small messaging
- Point-to-point large messaging
- Point-to-multi-point small messaging
- Point-to-multi-point large messaging
- Publish-subscribe messaging

To achieve maximum flexibility and operational efficiency, AGIE provides for two types of message delivery processes:

- Direct delivery from origination to destination
- Indirect delivery that allows intermediate storage of data before final delivery to the destination

5.3.3   Interoperability

The AGIE standard allows elements of AGIE implementations developed by independent developers to operate seamlessly in a single AGIE system and facilitates seamless adaptation and re-use across system implementations. The four primary areas of interoperability are:

- Between independently developed AGIE Clients and AGIE Servers
- Between independently developed AGIE Servers and AGIE Servers

- Common configuration management from an administrative point of view
- Re-usability of components, functions, and subsystems across independent implementations

5.3.4   Security

The AGIE standard allows flexible selection of features to meet the particular requirements of the implementation, which may support a range of security, certification, and operating parameters. AGIE leverages existing standards and best practices to the maximum extent possible of the security functions present in other layers and devices of the overall information systems environment. Furthermore, AGIE leverages the IETF Transport Layer Security (TLS) standard, ARINC 842 Standard, and ATA Specification 42 as well as the security features that are an integral part of protocols chosen to be part of AGIE, e.g. TLS within AMQP. Thus, the security guidance provided by the AGIE standard specifically addresses user needs for protecting aviation data and addresses the following:

- AGIE functions
- Interfaces to external systems
- AGIE administrative operations

5.4   Overview of Relevant OGC Standards

5.4.1   Introduction

In order to accommodate future Air Traffic needs, the Aviation industry is working on a framework to realize a "paradigm shift" from legacy systems towards flexible and interoperable Aviation Information Management systems. This framework is built extensively on standards, digital data exchange and process automation. At the heart of this new *Aviation Information Management* paradigm are standardized information exchange models - such as the Aeronautical Information Exchange Model (AIXM) - which cover relevant Aviation domains (for example Aeronautical Information Management [AIM], Weather, and Flight). Information encoded according to these models will be exchanged via standardized, reusable, and loosely coupled service interfaces that will enable System Wide Information Management (SWIM). Through projects such as OGC Testbeds, OGC Pilots and SWIM Master Class(es)[1], OGC standards have proven to facilitate and enable SWIM interoperability on a global scale.

The OGC is an international consortium of more than 450 companies, government agencies, research organizations, and universities participating in a consensus process to develop publicly available geospatial standards. The developments are based on and harmonized with international standards (e.g. ISO, W3C, OASIS). OGC standards enable the interoperable exchange of geospatial information, in what is generally called a Spatial Data Infrastructure (SDI). Because geospatial information is a key aspect in many communities, OGC standards are being used in domains such as Defense & Intelligence, Meteorology & Oceans, Sensing & Sensor Webs, and Aviation.

OGC standards facilitate a wide range of use cases. With respect to Aviation, they support the following functionality:

- Discovery of information and services that meet an application's or user's needs;
- Access to and dissemination of geospatial information:
    - as feature and coverage data - which is often referred to as "vector" and "raster" data;
    - filtered, projected and transformed according to user needs;

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[1] OGC Web Services Phase 6 (demo) page: http://www.opengeospatial.org/pub/www/ows6/index.html
OGC Web Services Phase 7 (demo) page: http://www.opengeospatial.org/pub/www/ows7/index.html
FAA SAA Dissemination OGC Pilot (demo) page:
http://www.opengeospatial.org/pub/www/saa/index.html
OGC Web Services Phase 8 (demo) page: http://www.opengeospatial.org/pub/www/ows8/index.html
OGC Web Services Phase 9 (demo) page: http://www.opengeospatial.org/pub/www/ows9/index.html
SWIM Master Class 2012 page: http://www.sesarju.eu/programme/workpackages/swim/swim-innovation-master-class

- portrayed using pre-configured or client-specific styles and symbology, and provided as maps or created on-the-fly;
  - delivered upon request or whenever relevant information is available;
- Execution of common processing tasks, such as computing the geometry of aeronautical features and creating customized maps for inclusion in pre-flight information bulletins;
- Securing service access to ensure integrity and confidentiality of the information.

5.4.2   OGC Standards for Aviation

OGC standards and specifications are publicly available on the OGC website[2]. They can be assigned to two groups: information models and service interfaces. The former specify how geospatial information is modeled and encoded, while the latter specify how relevant information is accessed and disseminated in the system.

The following sections provide a brief, non-exhaustive overview of relevant OGC standards and specifications that can be used as building blocks for interoperable Aviation Information Management systems.

5.4.2.1   Information Models

- **Geography Markup Language (GML) –** GML defines encodings for spatial data types (points, lines, polygons, etc) as well as rules for encoding application schema and geospatial features. It is used as the foundation for many information exchange models, for example AIXM and WXXM.
- **Guidance and Profile of GML for use with Aviation Data –** This specification provides further definitions and guidance on those parts of GML that are specifically relevant in an Aviation context.
- **Styled Layer Descriptor (SLD) / Symbology Encoding (SE) –** A styled layer descriptor document is used to control the presentation of a map portrayal. Symbology Encoding is used to encode how feature and coverage data is actually portrayed.

5.4.2.2   Service Interfaces

- **Catalogue Service for the Web (CSW) –** The CSW defines an interface to discover, browse, and query metadata about data, services, and other potential resources available in the system at run time.
- **Web Feature Service (WFS) –** The WFS defines an interface with operations to discover, insert, update, query/retrieve and delete feature data. This includes aeronautical features (encoded in AIXM), meteorological features (encoded in WXXM) as well as a variety of additional feature-based information.
- **WFS Temporality Extension –** The WFS Temporality Extension adds specific support to WFS for managing dynamic / time-varying feature data, specifically AIXM.
- **Web Coverage Service (WCS) –** The WCS defines operations to discover and query/retrieve coverage data, for example terrain and weather data.
- **Web Map Service (WMS) –** The WMS provides a uniform access interface for web clients to ask for and receive map "pictures" of geospatial feature and coverage data. The WMS therefore provides a simple way for clients to display potentially large and complex datasets. The WMS can for example be used to show aeronautical features and meteorological phenomena in front of a background map in a single picture.
- **Feature Portrayal Service (FPS) –** The FPS is an extension of WMS. It enables the portrayal of feature and coverage data, represented in "pictures" created by the WMS, with pre-configured or user-defined symbolization, using SLD/SE.

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[2] OGC specifications can be found at http://www.opengeospatial.org/standards

- **Event Service –** The Event Service adds publish/subscribe functionality to the system. It enables the creation and management of subscriptions to geospatial information. The Event Service notifies subscribed users whenever relevant information is available. This is applicable to the publication and receipt of changes to aeronautical features (represented as Digital NOTAMs), for example. It can also be used to inform users of new information available in the system, for example new weather and/or flight information.