FEDERAL AVIATION ADMINISTRATION

Aircraft Access to SWIM Implementation Guidance Document

Version 2.0

3/1/2013

FOREWORD

This document describes the implementation guidance for the AAtS concepts as it presently exists with a one-way communication of information (Ground to Aircraft). Additionally, as the AAtS concepts are defined in a collaborative environment, both major and minor changes to this document will be reflected in future versions. Therefore, it is expected that multiple versions will be released as the AAtS effort progresses.

EXECUTIVE SUMMARY

The Federal Aviation Administration's (FAA) Next Generation Air Transportation System (NextGen) program is a comprehensive overhaul of our National Airspace System (NAS). It is intended to provide new aviation capabilities for both users and operators; improve system capacity, throughput, and safety; ensure safe, secure, dependable, and hassle-free travel; and reduce the impact of aviation on the environment. The NextGen Implementation Plan identifies seven (7) transformational programs required to implement NextGen. One such transformational program is the System Wide Information Management (SWIM) program. SWIM will allow a more cohesive and efficient decision making process and also enable such new aviation concepts as trajectory based operations and optimum profile descents. SWIM infrastructure is being designed to use a Service Oriented Architecture (SOA) to communicate aviation data and services without the restrictive, time consuming and expensive process of developing unique interfaces for systems used in the NAS.

Currently, there is not an efficient or effective ground-to-air mechanism for the data management, exchange, and sharing of commonly sourced SWIM-enabled NAS information with aircraft. This reduces the flight crew's scope of planning and ability to collaborate with air traffic control in making dynamic and strategic decisions during phases of flight. Thus, flight crews rely heavily on voice and other legacy communications for in-flight aviation information which increases the workload in the cockpit.

The Aircraft Access to SWIM (AAtS) initiative is the effort that will define how and what is necessary to connect SWIM shared services to aircraft during all phases of flight. This connection will provide operational data to support efficient use of strategic and tactical traffic management operations up to, but not including, uses that directly affect aircraft trajectories. It is important to realize that the AAtS initiative will not implement a specific infrastructure to create the actual link to the aircraft, but it will define a set of operational and technical requirements that will be used to drive that infrastructure.

AAtS will provide aircraft with a means to connect to a common collection of aeronautical services provided from multiple sources. Example sources include services from the FAA, Department of Homeland Security (DHS), airports and other information sources publishing to the SWIM platform. Using FAA SWIM services and a standards-based approach this will create a globally interoperable and shared aviation information environment. The AAtS initiative is intended to facilitate a common situational awareness so that flight crews can be involved in the collaborative decision making process. AAtS will provide a global extension of the NAS SOA to aircraft and will use an aircraft operator selected air/ground network services providers' infrastructure to allow aircraft to receive common NAS derived data.

This document describes a path to implementation that various stakeholders should follow for aircraft to access and consume SWIM-enabled NAS information. Stakeholders can use the guidance described herein to define their individual air/ground network infrastructure solution implementation leading to an operational approval for use. In doing so, aircraft become an extended information consumer that can enhance NAS efficiency by creating this common situational awareness environment.

Version	Description of Change	Author	Date
1.0	Contextually aligning Version 1.0 of the AAtS Integrated Requirements Document to derive this guidance document	F. Aknine / M. de Ris	7/16/2012
2.0	Adjudication of AVS comments, other edits/comments, and added Appendix E – Comments and Resolution Matrix	L.Yee / M. de Ris / F. Aknine	03/01/2013

TABLE OF CONTENTS

List of Figures

List of Tables

1.0 INTRODUCTION

The Next Generation Air Transportation System (NextGen) is a comprehensive overhaul of our National Airspace System (NAS) to make air travel more convenient and dependable, while ensuring flight operations are safe, secure and efficient as possible [1]. The transformation to NextGen requires capabilities and technologies enabling more efficient operations. The System Wide Information Management (SWIM) program is an integral part of that transformation. SWIM is an information platform that will facilitate simultaneous sharing of information available from the various NAS information systems among flight crews, Air Traffic Management (ATM), airline dispatchers, the military, government agencies, and other users of the NAS.

Currently, the NAS consists of systems that are custom designed, developed, managed, and maintained individually at a significant cost to the Federal Aviation Administration (FAA). The current infrastructure and systems cannot readily support the addition of new data, systems, data users, and/or decision makers as NextGen requires. NextGen relies upon a new decision construct that brings more data, systems, customers, and service providers into the process. To facilitate aircraft in accessing SWIM-enabled NAS data, the Aircraft Access to SWIM (AAtS) initiative expects to deliver a conceptual framework to achieve enhanced common situational awareness and involve the aircraft in the collaborative decision making process.

The AAtS concepts will provide a globally interoperable extension of the NAS Service-Oriented Architecture (SOA) to aircraft allowing a common shared aviation information environment. Operators employing the connections described herein will use an air/ground network services providers' infrastructure selected by that operator to exchange data between the aircraft and the NAS.

1.1 Purpose

The AAtS Implementation Guidance Document 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:

- 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

1.2 Scope

The AAtS Implementation Guidance Document 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

The methodology followed to develop the concepts and functionality described herein included:

- Reviewing the existing AAtS research studies, analysis reports, and discussions with the FAA stakeholders. The source materials, listed in the reference section of this document, provided a good researcher-based perspective of the desired and achievable AAtS functionality
- Developing an AAtS Initial Concept of Use document with use case scenarios
- Building the architecture products in accordance with the NAS Integrated Systems Engineering Framework (ISEF). The products selected for this architecture are based on RTCA SC-206 concepts of use [9] and are designed to describe the AAtS functional and system environment in sufficient detail to ensure completeness and rigor to the final

product of enabling an external user to connect aircraft to SWIM and interact with NAS services

- Consulting subject matter experts (SMEs) on topics related to operational and technical concepts, policies, and regulatory guidance that will impact the AAtS initiative

1.3 Background

NextGen is designed to increase efficiency and capacity, improve safety, and to provide more choices to aircraft operators. The transformation to NextGen operations requires capabilities and technologies enabling more efficient operations, including streamlined data communications. SWIM is one of seven (7) transformational programs within the NextGen portfolio of programs designed to improve information exchange with NAS users. The concept of AAtS is to extend SWIM-enabled NAS services to the aircraft while providing the greatest amount of flexibility for the industry to realize a wide range of potential uses.

1.3.1 SWIM Overview

The SWIM program and infrastructure provides an open, flexible, and secure information management platform for sharing NAS data and enabling increased common situational awareness and improved NAS agility. This infrastructure supports information exchanges between NAS systems by using the principles of SOA. SOA is an architectural approach for organizing, sharing, and using NAS services to support interoperability by decoupling the service connections. This decoupling allows and promotes the reuse of services in an enterprise and eliminates duplicative functionality across organizational boundaries. SOA helps organizations align their software applications with business requirements and provides the flexibility and agility to adapt and respond to business/enterprise changes in a better, faster, and more cost effective manner.

SWIM supports the integration of NAS services by providing a platform that allows information exchanges between NAS programs. To provide proper integration, functioning, and utilization of services, the SWIM provided infrastructure offers message exchange mechanisms, discovery of services, service performance monitoring, and a secure execution environment.

To support message exchange mechanisms, SWIM provides NAS Enterprise Messaging Services (NEMS). NEMS services are delivered as a shared utility, “infrastructure-as-a-service”, for NAS-wide FAA application system use. This shared infrastructure provides the common tools and application programs required to produce and consume information across the NAS enterprise. To support the SWIM mission, NEMS leverage the FAA Telecommunications Infrastructure (FTI) program assets by integrating a messaging infrastructure into the existing monitoring and control systems. This messaging infrastructure supports the SWIM mission by providing information system security and enterprise service management assets for 24x7x365 monitoring and operational maintenance processes. NEMS are also integrated with the NAS Enterprise Security Gateway (NESG). This integration supports information exchanges between NAS and non-NAS entities using security mechanisms provided by the NESG and data exchanges provided by NEMS tools. Examples of the type of data that can be exchanged through NEMS include flight data, traffic flow management, aeronautical information, weather data, etc.

Figure 1-1 depicts the data/information flow and functionality in which internal NAS Services are produced by NAS providers and are made available on the SWIM SOA platform. These services are then accessible to other authorized NAS or non-NAS consumers. The internal providers of NAS Services leverage FTI to connect to a secure Service Access Point (SAP) that routes data to the closest NEMS messaging node (NMN). The NMN provides an intelligent routing to select the appropriate communication path based on the data content and re-route data in case of a node failure. The NEMS also provides mediation capability. This capability enables service producers and consumers to exchange data using various communication protocols and data formats. This further facilitates the sharing of data among each other and with external NAS or non-NAS Service providers and consumers. Once the data is received by the NMN, it is routed to all of the other NMNs on FTI. This includes the trusted and un-trusted NMNs hosted on NESG.

The NESG provides a variety of security controls. Anti-virus, firewall, intrusion detection, a routing/switching capability, and a Virtual Private Network (VPN) concentrator are all used to separate and protect the NAS from outside elements. The NESG establishes two areas consisting of trusted and un-trusted NMNs known as de-militarized zones (DMZs). The trusted NMNs are used as an interface between internal NAS Service producers and consumers to ensure the integrity and security of the shared data. To meet the needs of an external or non-NAS consumer, the trusted NMNs pass data through a firewall to un-trusted NMNs. Thus, the external NAS or non-NAS consumer wanting to obtain NAS data/information does so by accessing and subscribing to the un-trusted NMN on the NESG via an external VPN connection to FTI.

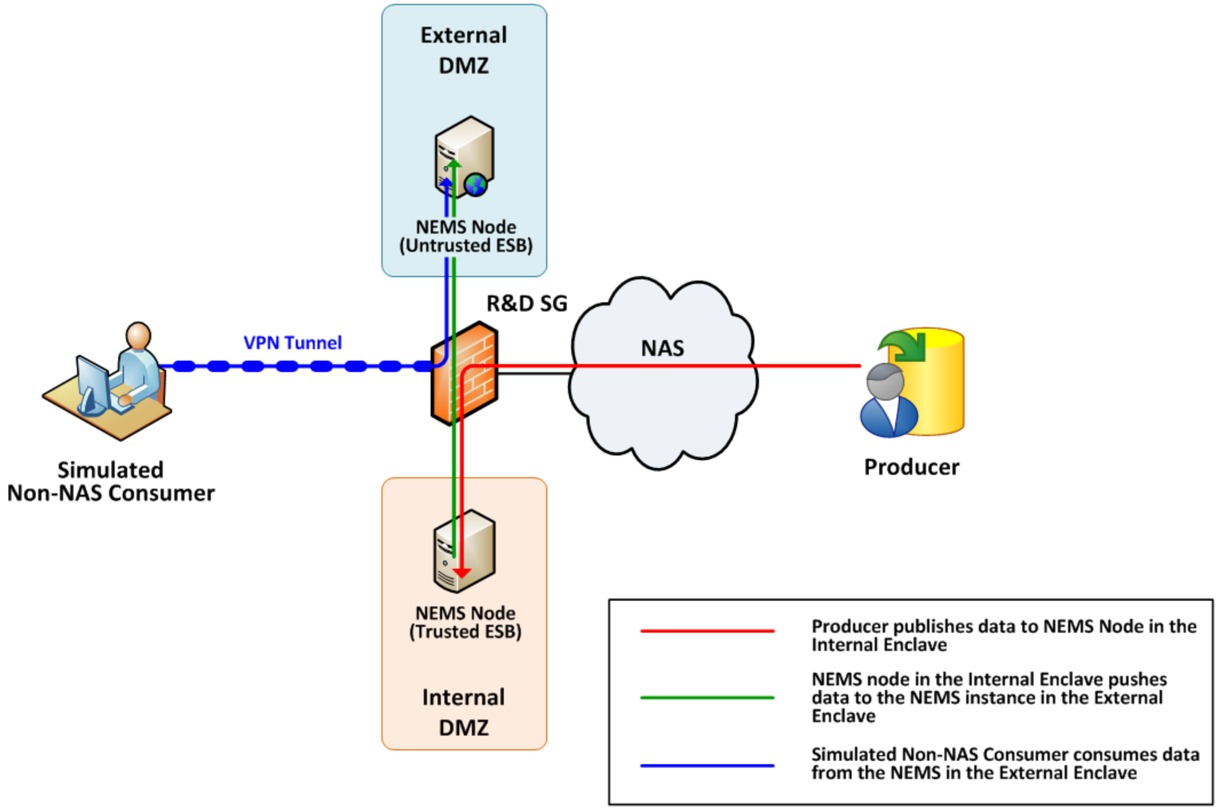


Figure 1-1 – NAS Data Flow from NAS Service Producer to Non-NAS Consumer

Individual NAS Service discovery is realized through the NAS Service Registry/Repository (NSRR). The NSRR provides a single place to organize, understand, and manage SOA-related information. In particular, the NSRR stores information services (meta-information) as well as the relationships between those services. Service meta-information includes the service description, classifications (e.g., protocol types), service category, delivery channels, and access information.

In order to facilitate this information-sharing community, SWIM maintains governance which asserts interoperability and reuse as key goals. SWIM has a governance body that applies the Service Life Cycle Management Process (SLMP) against NAS services which are using the SWIM infrastructure to share information and functionality across the NAS. Service Providers could be represented by a NAS Program(s), other government agencies/organizations or commercial organizations which provide information services via SWIM. The Service Provider may provide more than one SWIM-compliant service. However, each additional service needs to follow the Service Life Cycle Management Process (SLMP) as defined by the SWIM Governance to become a SWIM-compliant service. The NSRR also supports governance and life cycle management of NAS services. NSRR provides a control point for governance in the NAS by enforcing conformance to policies defining how NAS services should be provided and consumed. NSRR also provides a platform for managing NAS service meta-information throughout the service life cycle. At each life cycle stage, NSRR enforces different policies on the meta-information published for the services that are relevant to that stage.

Putting all of this into context for AAtS, an implementer of AAtS concepts is considered to be a non-NAS consumer wanting to receive NAS data. They will have to obtain the data using a VPN connection to the un-trusted NMN on the NESG. Thus, the AAtS stakeholder must implement all of the requisite requirements, procedures, and processes necessary to have access to and become an authorized consumer of NAS data available on the SWIM SOA platform.

1.3.2 AAtS Concept Overview

AAtS is the effort to define how to provide a connection from SWIM SOA shared services to an aircraft whether it is on the ground or in the air. AAtS based services will help create common situational awareness shared with the air traffic management (ATM) and Airline Operations Centers/Flight Operations Centers (AOCs/FOCs) throughout the entire flight. With AAtS the flight crew moves from being an isolated operator to an engaged, collaborative decision maker [2]. The AAtS initiative does not intend to implement a specific infrastructure to create the actual link to the aircraft. Rather, it will define a set of operational and technical requirements or expectations that will be used to drive the infrastructure and guidance necessary for operational approval of AAtS.

1.3.2.1 Mission

The overall AAtS initiative mission is to enable connectivity between aircraft and the NAS services being implemented on the SWIM infrastructure. This connectivity will provide NAS operational data intended to support uses that affect the efficiency of air traffic management operations up to, but not including, uses that directly affect the trajectory of the aircraft. Data delivery uses that do directly affect the trajectory of the aircraft are those that involve Air Traffic Control (ATC) clearances and instructions or information that supports unilateral action by the flight crew without consultation with ATC. These types of uses will leverage higher performance communication paths certified to handle critical information such as the FAA’s Data Communications system as defined by the Data Communications Integrated Services (DCIS).

1.3.2.2 Vision

The AAtS initiative will provide aircraft with a means to connect to a common collection of aeronautical services provided from multiple sources including the FAA, DHS, airports, and other information services.

1.3.2.3 Goal

The goal of the AAtS initiative is to facilitate a common situational awareness so that flight crews can be involved in the collaborative decision making process. AAtS will provide a global extension of the NAS SOA to aircraft and will use an aircraft operator selected air/ground network services providers' infrastructure to exchange data between aircraft and the NAS.

1.3.2.4 Objectives

The AAtS initiative objectives include:

- Creating a common decision-making framework between aircraft and the NAS
- Providing ground to air and air to ground data exchanges between NAS services and aircraft
- Providing aeronautical, weather, and operational flight information to flight crews and operators
- Supporting global interoperability between AAtS users and other ANSPs

It should be noted that while AAtS intends to support global interoperability, the fundamental concepts of SWIM and the SWIM based connections to the aircraft are subtly different throughout the globe. Some efforts decouple the air-to-ground connections from the implemented ANSP solution and others include it. Some efforts provide high level guidance, such as this effort, whereas other efforts stipulate specific technologies. The FAA's AAtS concepts are based upon the notional frameworks expressed within RTCA's SC-206 DO-308 *Operational Services and Environment Definition (OSED) for Aeronautical Information Services (AIS) and Meteorological (MET) Data Link Services*, December 2006 [8], DO-324 *Safety and Performance Requirements (SPR) for Aeronautical Information Services (AIS) and Meteorological (MET) Data Link Services*, December 2010 [17], and DO-340 *Concept of Use for AIS and MET Data Link Services*, September 2012 [9]. It is this foundation, along with an effort to coordinate where possible with other global partners, which contributes to global standardization, interoperability, and harmonization of AAtS.

1.3.2.5 Assumptions

This document has been developed using the following assumptions:

- NAS services will be available via the SWIM infrastructure
- NAS services will be provided at the NAS Enterprise Security Gateway (NESG) through SWIM SOA services for qualified subscribers
- External data management services and data links will be available and found acceptable by the relevant authority per the guidance contained herein

- A version of the NSRR is available only to registered users to enable a prospective DMS Provider to determine whether it wants to connect to SWIM
- AAtS is largely "network agnostic"
- The selected network needs to have sufficient bandwidth to support the desired services
- The AAtS implemented solution will not interfere with avionics essential to managing the trajectory of the aircraft
- AAtS provided information is not intended for command and control purposes and will leverage Category 1 or Category 2 data link delivery services [9]
- The implemented AAtS concept solution is available 24x7x365
- The service is available to each aircraft. The AAtS service is considered "available" even if the aircraft is not connected into it
- Data quality requirements (DQR) are outside the scope of this document; however, it is assumed that the source data to be delivered to aircraft will meet the quality needs to support the intended use,

1.3.2.6 Constraints

This document has been developed within the following constraints:

- FAA has no plans to acquire systems, hardware, or software to directly support AAtS

1.4 Organization of Document

This document is organized as follows:

Section 1 – Introduction

- This section describes the purpose, scope, and background of the Implementation Guidance Document.

Section 2 – AAtS Concept

- Operational Need – describes the current flight crew constraints
- Operational Concept of Use – describes the solution(s) to satisfy the need
- Operational Use Case Scenarios – describe how a system operates under specific conditions. Scenarios will test the utility of AAtS services under expected operational conditions with intended users of these services.
- Operational Activities and System Functions – describe the operational activities and system functions

Section 3 – Implementation Guidance

- Establish business and data exchange agreements – The aircraft operator selects the service provider(s) that will establish the relevant connections and agreements with FAA
- Implement and test AAtS capabilities – The aircraft operator develops AAtS concept capability functionality, the DMS performs NESG network and service testing, and the aircraft operator performs DMS to aircraft test and evaluation
- Receive Operational Approval – The aircraft operator receives operational approval from AVS

Appendices

- Appendix A – References
- Appendix B – Acronyms and Glossary
- Appendix C – Operational Use Case Scenarios
- Appendix D – Traceability Matrix\
- Appendix E – Comments and Resolution Matrix

2.0 AATS CONCEPT

This section describes the high level operational concept needed to communicate key operational aspects of the system. The following communications objectives were developed to focus the concept:

- Provide aircrews with the same information available to other components of the NAS via SWIM
- Provide ground-to-air information exchanges between aircraft and NAS services

2.1 Operational Need

Current flight crew constraints to accessing aviation-related information include:

- No consolidated NAS data source for all available aviation-related information
- No air to ground capability for flight crews to obtain shared NAS services and information
- Heavy reliance on voice communications which can create the following issues:
    - Read back clarity
    - Frequency congestion
- Limited access to current NAS information and services by the flight crew can cause inefficient decision making and strategic planning.

These constraints narrow the scope of and limit the ability of NAS users to make dynamic decisions and reduce the agility of NAS operations. As a result, the flight crew does not have a complete picture of the NAS environment and timely distribution of NAS information is important for the flight crew to make informed decisions [2].

2.2 Operational Concept of Use

AAtS will address and eliminate the above constraints by delivering the air-ground solution that provides aircraft access to SWIM information throughout the entire flight. AAtS will use the existing NAS and aircraft infrastructure (e.g., SWIM, FTI, and Electronic Flight Bags (EFBs)) to create a common situational awareness environment with the ANSP and operation centers by delivering consistent and timely non-critical operational information to the flight deck. This information is intended to support but not directly change the trajectory of the aircraft. Examples of non-trajectory affecting information include wind, temperature and turbulence information for presentation to the pilot or upload into the flight management function (FMF). However, the services used for delivering that information must meet the performance characteristics necessary for supporting the intended use.

Trajectory changing messaging will be handled by higher performance communication systems certified to handle critical information such as the FAA’s Data Communications system as defined by the Data Communications Integrated Services (DCIS) and Surveillance and Broadcast Services (SBS). For the purposes of this document, critical information is described as information that directly affects the trajectory of the aircraft. Examples of trajectory affecting information include aircraft clearances, aircraft instructions, and other data exchanges that cause unilateral changes in the aircraft trajectory without further interaction with the relevant Air Traffic Control facility. This non-critical information access can allow the flight crew to proactively plan for events such as severe convective weather and to ensure the most safe and efficient flight. With AAtS, the flight crew starts to move from being an independent and somewhat isolated sole operator to an engaged, collaborative decision maker.

AAtS will enable the flight crew to shift from current tactical to strategic gate-to-gate management of flight operations. As SWIM adds services, AAtS subscribers will benefit from the enhanced weather, aeronautical, and Traffic Flow Management (TFM) services and associated information.

Access to the full suite of weather data and information provided by SWIM will give the flight crew the ability to monitor weather system development and other operational changes in near-real-time and to prepare for those changes. In addition, accessing TFM data via AAtS concepts may allow the flight crew to learn of planned Traffic Management Initiatives (TMI) well before it is implemented. This will give them an opportunity to adjust their plans and mitigate the impacts on their flight. Having access to AAtS, flight crews will not be solely dependent on potentially overloaded service providers to broadcast information that may or may not be helpful [2]. In an effort to explore these benefits, the following section will detail four operational use case scenarios designed to illustrate the potential uses of AAtS.

2.3 Operational Use Case Scenarios

Operational use case scenarios demonstrate how a system will operate under specific conditions. Scenarios will test the utility of services under expected operational conditions with intended users of these concept services. It is expected that multiple use case scenarios will be developed as the AAtS concept matures. The scenarios described in Appendix C – Operational Use Case Scenarios of this document provide initial, high-level operational descriptions of AAtS in the far-term and how the types of SWIM-enabled information (Flow Management, Weather, Aeronautical Information, and NAS Status Information) delivered to aircraft will be used.

AAtS users will either work with third-party vendors to develop specific application requirements based on their operational needs for accessing SWIM-enabled NAS services or develop them in-house. These will include user-defined data access requirements and the method for accessing and displaying the data/information. This proposed application supports collaborative decision-making and situational awareness.

Each scenario will progress through each phase of flight. The goal is to identify what information AAtS can provide to improve the situational awareness of the flight crew to aid their decision making. Each scenario is designed to show the operational benefits of AAtS to stakeholders and the NAS. These scenarios include comparative descriptions to highlight the operational benefits between the current delivery and use of NAS information versus future state AAtS implementation.

Each use case scenario was created with a specific purpose and goal to highlight. Each use case scenario will cover a different event in the NAS, demonstrating how AAtS is envisioned to be used in the NextGen environment. Table 2-2 includes an overview of the main themes of the operational use case scenarios.

Scenario	Purpose	Route	Conditions	Actors
Transcontinental Airline	Fully exercise AAtS capabilities and identify benefits under normal operating conditions with on-demand NAS information	Transcontinental LAX-JFK	VMC, during the afternoon peak demand period	Flight Crew, AOC/FOC, ATM
Domestic Flight (snow impacting ORD and IAD)	Demonstrate use of AAtS during predictable adverse weather conditions	Domestic flight: ORD-IAD	Snow impacting ORD and IAD, snow removal at both airports with runway closures, deicing at ORD causing reduced Arrival/ Departure Rate	Flight Crew, AOC/FOC, ATM
Domestic Flight (severe weather event)	Demonstrate use of AAtS during unpredictable adverse weather conditions that impact route during flight	Domestic flight; SFO/ORD	Convective weather conditions En route not impacting arrival airport	Flight Crew, AOC/FOC, ATM
Domestic Business Jet (GA) on-demand (unscheduled) flight operating	Demonstrate AAtS use by GA flight without AOC/FOC support	Domestic GA flight: PWK/IND second flight RFD/IND	VMC weather conditions changing to IMC	Flight Crew, ATM

Table 2-1 – Operational Use Case Scenarios

The guidance provided in this document while representative of the anticipated uses of AAtS, are illustrative since they assume that the scenarios are valid (will occur) and that the players in the scenarios will act as described in the scenarios. This document, with its focus on the four ConUse scenarios, does not address all the potential users or uses of AAtS. It will be up to the eventual aircraft operator who will be seeking the operational approval of these services to describe the specific uses AAtS will be employed to support.

The following subsections provide a framework of operational use from which the guidance to achieve operational approval of the intended use is derived. Specific stipulation of the intended use by the aircraft operator is required in order to determine the safety hazards and ensuing performance characteristics of the delivery method. The subsections describe the operations of the entities between the NESG and the aircraft user that need to be addressed to connect the aircraft to the SWIM-enabled NAS services. It is the responsibility of the individual seeking operational approval to properly address the operations and system functions contained herein.

2.3.1 Aircraft

The aircraft consumes data that consists of aeronautical data, air traffic management (ATM) data, and weather data. The aeronautical data includes, but is not limited to, notices to airmen (NOTAMS), and special activity airspace (SAA) which includes temporary flight restrictions (TFRs). The ATM data includes, but is not limited to, traffic flow, playbook, traffic management initiatives, terminal movement, and arrival data. The weather data is the data about the meteorological conditions in a specific area that includes observations and forecasts.

Currently, the aircraft does not have a complete picture of the NAS environment. Most of the information transferred to the aircraft is via voice communications and often the aircraft must rely on static information provided before departure. This means that information about general weather forecasts, NAS constraints and in place TMIs can be hours old when the aircrew reviews them in flight. Old and out-of-date information in the aircraft leads to uneven knowledge among cockpit crews, traffic management, controller, and AOC/FOCs. This contributes to inefficient planning, excessive time lapses, a need for additional communication (to compensate for the quality and timeliness of information), and lower aircraft situational awareness levels.

With AAtS, the aircraft consumes data that is provided by the DMS through a Data Link Service (DLS) Provider(s) using data derived from NAS Data Services' compliant connection to the SWIM infrastructure. This will be used, in conjunction with other information, by aircrews to make decisions in support of the defined intended use. In order for the aircraft operator to achieve operational approval, the aircraft must operate in an environment that maintains the following:

- Secure flow of data – enforces service and message security policies, verifies identities and digital signatures and provides authorization-based access
- Connectivity that enables the aircraft to communicate with entities on the ground such as the DMS Provider
- Subscription and data request configuration – maintains the configuration parameters used to establish and modify subscriptions and recurring data requests
- Data validation – describes the messages that are required to communicate the validity, timeliness, and continuity of data to an aircraft

Thus, it is the responsibility of the aircraft operator to address how the aircraft will use the data provided by AAtS concepts during all phases of flight that includes pre-flight, pushback, en route, and descent/arrival. This “use of the data” is described as the intended use.

2.3.2 DMS Provider

The DMS Provider provides the primary functionality needed to manage the flow of data and the connectivity between the NESG, aircraft, DLS, and any external access to DMS necessary for the user to manage its service. DMS functionality potentially includes managing communications, the application of technical rules, and other various sub-functions. In order for the aircraft operator to achieve operational approval by AVS, the DMS must address the following operations:

- The establishment of network and service connections – this includes the processes and agreements involved in connecting the DMS to NESG and the DMS to the aircraft
- The service registration that includes how users plan to register for and what data services are to be registered for using the NSRR.
- The management of communications – this include managing secure communications, performing any necessary protocol translations between the NESG and the onboard client, performing compression and expansion of data, managing wireless communications, and monitoring network performance
- The management of the application of technical rules – this includes data synchronization rules, data validation rules, data filtering rules, subscription and data request configurations, data provenance rules, and population of priority and security data fields

It is the responsibility of the aircraft operator to address how the DMS Provider will make the data available to the aircraft during all phases of flight that includes pre-flight, pushback, en route, and descent/arrival.

2.3.3 External Access to DMS

The DMS is a complex set of functions that enable an efficient and secure means of exchanging NAS services with aircraft through the use of SWIM services. It would not in all cases be effective nor economical from a human factors perspective to require that the full management of the various configuration policies and procedures available to the user be managed by the aircraft. The functionality known as the External Access to DMS allows a user to manage these multiple and complex permutations. This functionality could be realized in multiple locations depending on the operational environment and the intended use. Some examples include:

- Through the onboard client
- A secure web portal
- A dedicated secure connection to the operators AOC/FOC or combination of other back end systems

The aircraft operator must address the following External Access to DMS operations in order to achieve operational approval:

- The method and extent of data synchronization – this provides a means to monitors the data that is exchanged between the aircraft and the DMS
- The method and extent of the subscription and data request configurations – this provides a means to set the configuration parameters used to establish and modify subscriptions and recurring data requests
- The level of network performance and the means to assure continued performance – this includes the monitoring of the performance metrics and data validation function

There are several different operating rules that flights are operated under. Under different operating certifications, the rules governing the aircraft and the company's flight department differ, but all utilize the airspace the same way. For instance, flights conducted under 14 CFR Part 121 use an Airline Operations Center (AOC), whereas those conducted under 14 CFR Part 91 do not have a specific requirement to do so. The first three use case scenarios are operating under 14 CFR Part 121. In use case scenario four, the flight is operating under 14 CFR Part 91. While not specific to any of the scenarios in this document, there are situations where 14 CFR Part 91 aircraft operators may contract with a "for-fee" flight planning service or Flight Operations Center (FOC). This service provides a flight planning function and weather briefing similar to an AOC.

It is the responsibility of the aircraft operator to address how the DMS Provider will make the data available to the External Access to DMS. In the above sample scenarios, the aircraft operator is the certificate holder in 14 CFR Part 121 operations. When aircraft operator is referred to in a 14 CFR Part 91 operation, this applies to the Pilot in Command (PIC) of the given flight. The PIC must ensure that the systems used meet the needs of the intended use. In all cases, the External Access to DMS function is intended to improve situational awareness and decrease workload during all phases of flight. The data made available to the External Access to DMS is focused on the synchronization of information between the external ground user (e.g., AOC) and aircraft in 121 operations due to the joint safety responsibility between the Pilot in Command and the flight dispatcher. Other types of data exchange options associated with the External Access to DMS that the external ground user may employ include:

- Any initial subscription and data request configurations for the aircraft
- The establishment and management of the subscription and data requests to the SWIM-enabled NAS services that will feed the onboard client
- The establishment and management of the validation, provenance, and security rule sets from which the DMS will operate
- The establishment and monitoring of the performance of the implemented solution to include the performance of the implemented DLS

For further information on the capabilities of the External Access to DMS function, refer to section 3.2.1.3.

The AAtS concepts do not describe the connection between SWIM and the aircraft operators' AOC/FOC. This connection is considered out of scope for the concepts of AAtS since its purpose is to describe connectivity to the aircraft specifically. Connections between SWIM and the AOC/FOC already exist and should continue to exist after the advent of the AAtS capability. With that said, there is no reason why the DMS could not fulfill the data connection role to the AOC/FOC for the specific purpose of supplying the AOC/FOC with operational information for their own uses; it is just not described by AAtS.

2.3.4 Data Link Service Provider

The DLS Provider provides the data link (or physical layer) that enables the aircraft to communicate with entities on the ground such as the DMS Provider. It could include knowing where the aircraft is, using the best route for data, and making the connections to achieve the target end-to-end latency and availability. This data link needs to be capable of supporting the required performance necessary to support the defined intended use. A combination of multiple DLS Providers may potentially be used to support the desired performance characteristics.

It is the responsibility of the aircraft operator to address how the DLS Provider will make the connections between the DMS and aircraft to achieve the target end-to-end latency and availability during all phases of flight that includes pre-flight, pushback, en route, and descent/arrival to meet the intended use.

2.4 Operational Activities and System Functions

This section describes the activities that are normally conducted to connect the aircraft to SWIM and interact with NAS services. Also described in this section are the system functions associated with the AAtS concept. These functions are intended to establish a framework from which the aircraft operator can describe how data flows and the connectivity between the NESG, the onboard systems and/or display, and external users of the DMS in their specific implementation. These operational activities and system functions will be performed by a variety of government agencies and commercial entities that will require establishing rules of engagement, interagency agreements, policies, interconnection and data sharing agreements, and business rules.

The FAA intends to designate an AAtS governance body to guide and assist the relevant stakeholders through the process of obtaining a connection and consuming services. For the purpose of this document, this governance body is termed the AAtS Project Officer. This officer will coordinate the AAtS operational approval activities between:

- The FAA NAS program office that manages the systems and their associated data services
- The FAA Telecommunications Services Group (TSG) that provisions and manages all telecommunication services for the FAA including the NESG gateway
- The FTI vendor that installs and operates FTI services
- The FAA SWIM program office for the purposes of provisioning enterprise services and governance activities
- The DMS Providers that will make the connection to the NESG and then distribute the NAS services to their various customers
- The aircraft operator (in some instances)

The AAtS Project Officer will also need to coordinate these activities with the Flight Standards Service (AFS), Air Traffic Safety Oversight Service (AOV), and Aircraft Certification Service (AIR) within the FAA Office of Aviation Safety (AVS) to ensure that the correct points of contact are made and coordinated throughout the process. The following subsections describe the operational activities and system functions of the entities between the NESG and the aircraft user that are needed to enable the AAtS concepts. These activities and functions need to be addressed in order to achieve operational approval to connect the aircraft to the DMS services.

2.4.1 Operational Activities

Operational activities describe what actions are to be performed within the node. Ultimately, AAtS describes a functionality and concept to exchange aviation information between the FAA's SWIM platform and aircraft. The individual operational activities that go into that exchange include providing weather, ATM, and aeronautical information. These are the operational activities normally conducted when connecting the aircraft to SWIM and interacting with NAS services. Which ones or all are dependent on the intended use. Figure 2-1 illustrates these operational activities, whereas Table 2-2 provides the operational activity descriptions of AAtS.

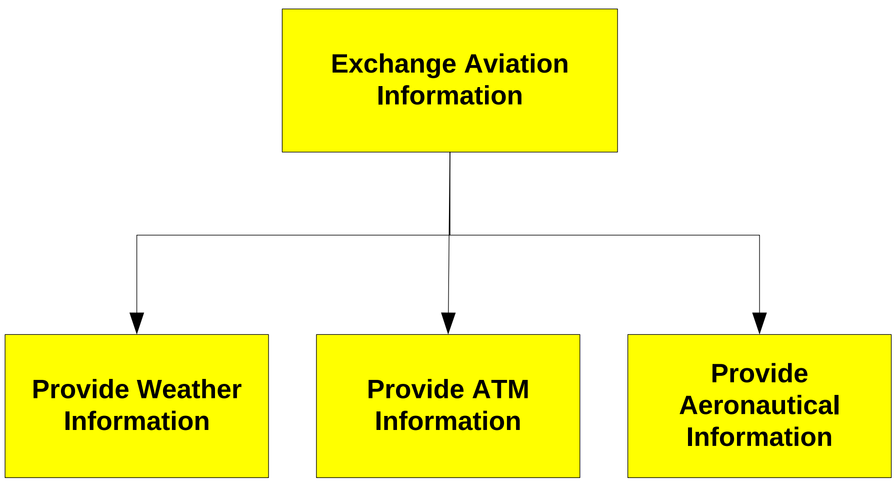


Figure 2-1 – AAtS Operational Activities

Activities	Description
Exchange Aviation Information	This activity includes the processes of establishing and managing communications, determining the information that will be subscribed to or requested, and managing the actual exchanges.
Provide Weather Information	This activity supplies weather information to users by ensuring the assets, people, procedures and policies that produce the information is in place.
Provide Air Traffic Management Information	This activity supplies air traffic management (ATM) information to users which includes, but is not limited to, flow information, Traffic Management Initiative (TMI) information, playbook information, etc.
Provide Aeronautical Information	This activity supplies aeronautical information to users which includes information such as notices to airmen, flight restrictions, special use airspace, etc.

Table 2-2 – AAtS Operational Activity Descriptions

2.4.2 System Functions

The system functions were developed by analyzing the use cases in the AAtS ConUse and the activities described above needed to satisfy the use cases. Additionally, these functions are intended to describe a fully realized and high functioning implementation which captures most of the intended uses. Most of the intended uses will not require the full suite of that described in the following sub-sections. For example, a general aviation implementation may not have a need for data synchronization with functions external to the DMS. Figure 2-2 illustrates a logical depiction of the end-to-end systems and interfaces.

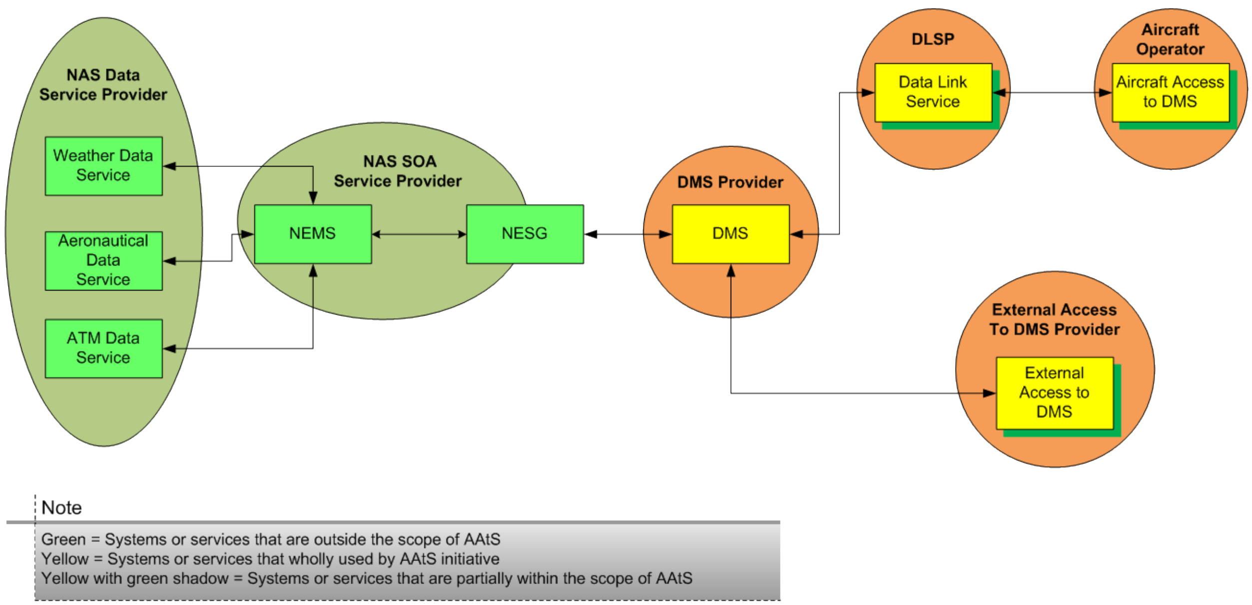


Figure 2-2 – End-to-End System Interfaces

The diagram introduces the concept of an intermediary service provider between the aircraft and the NAS enterprise. This intermediary service is required to provide data subscription and dissemination functionality while limiting the number of discrete NESG connections that the FAA must enable. For the purposes of this document, the intermediary service provider will be known as the Data Management Service (DMS). The DMS(s) will be developed by entities not within the NAS and will connect to SWIM through the NESG. It will distribute the SWIM-enabled NAS services data to its subscriber aircraft connected through a wireless air-ground DLSP. The aircraft operator, presumably through its external access to DMS (e.g., in a 121 airline environment, it will be the AOC/FOC), will also have a connection to these DMS Providers to support their managing the subscription and data request configurations for the aircraft as well as to monitor data that is sent to the aircraft. Table 2-3 describes the AAtS end-to-end system entities.

Entity	Description
Aeronautical Data Service	A service that provides aeronautical information such as notices to airmen, flight restrictions, special use airspace, etc.
Aircraft Operator	The entity responsible for ensuring the crew is appropriately trained and equipped. Additionally, they have the responsibility to maintain the aircraft and the aircraft systems. This entity is also responsible for interacting with the relevant regulatory bodies to achieve the operational approval to operate the aircraft in the intended environments using expected policies and procedures. Examples include: • Certificate holder in 14 CFR Part 121 operations. • Corporate Flight Department in 14 CFR Part 91F or 91K • Pilot in Command (PIC) in 14 CFR Part 91 operations. This PIC must ensure that the systems used meet the needs of the intended use. Relevant guidance for self-certification can be found in: o AC120-76B – *Guidelines for the Certification, Airworthiness, and Operational Use of Electronic Flight Bags (EFB)* [18] o AC91-78 – *Use of Class 1 or Class 2 Electronic Flight Bag (EFB)* [19] o AC91-21.1B – *Use of Portable Electronic Devices Aboard Aircraft* [20] o For integrated installed solutions, the PIC needs to be familiar with and follow the guidance contained in the supplied flight manual(s).
Aircraft Access to DMS	This is a set of functions that manages the aircraft connection with the DMS in support of the intended use. These functions are hosted by a variety of onboard systems that may include, but is not limited to, flight management, informational, video surveillance, and sensor systems. These systems also include all classes of EFBs as defined by AC120-76B [18] and AC91-78 [19].
External Access to DMS Provider	The External Access to DMS Provider manages the systems necessary to support the business operations of the External Access to DMS functionality.
External Access to DMS	External Access to DMS is the functionality that enables an external user to set rules, and parameters. Additionally, it allows the user to monitor system performance and data synchronization
ATM Data Service	Provides data such as traffic flow, playbook, traffic management initiatives, terminal movement, and arrival data.
Core Services	SWIM Core Services include the messaging and management functions needed to support SWIM operations.
DMS	The Data Management Service is that set of functions that are needed to manage connections between aircraft and the NESG. Additionally, it maintains a number of data sets needed to manage transactions with the Security Gateway, aircraft, and external users. Lastly it manages the communications links with the aircraft and SWIM as well as validating and filtering data and monitoring network performance.
DMS Provider	The DMS Provider manages the systems necessary to support the business operations of the Data Management Service functionality
NAS Data Service Provider	A SWIM-enabled NAS Program that makes data accessible via SWIM compliant services.

Entity	Description
NAS Enterprise Security Gateway	The NAS Enterprise Security Gateway is a framework for supporting mandated boundary protection services between SWIM and external entities. It provides a standardized scheme for connecting and managing connections to external users. It also enables a layered security scheme to provide defense in depth and provide a buffer between SWIM and external entities.
SOA Core Service Provider (SWIM)	SWIM Core Services include the messaging and management functions needed to support SWIM operations.
Data Link Service Provider (DLSP)	This DLSP provides the wireless data link (or physical layer) that enables the aircraft to communicate with entities on the ground such as the DMS Provider.
Data Link Services (DLS)	The data link service manages and provides the wireless connections between the ground and aircraft, including knowing where the aircraft is, and making the connections to achieve the target end-to-end latency and availability.
Weather Data Service	A source of information about weather including observations and forecasts.

Table 2-3 – End-to-End System Entity Description

This document provides a basis and a framework from which the guidance for the operational approval of the intended uses can be derived. It describes the functional entities between the NESG and the aircraft that need to be addressed to connect the aircraft to the SWIM services. This includes providing a description of the functionality of those illustrated by Figure 2-3 as being within scope. Figure 2-3 illustrates the information flows, data exchanges and system entities between the aircraft, DLSP, DMS Provider, and external access to DMS.

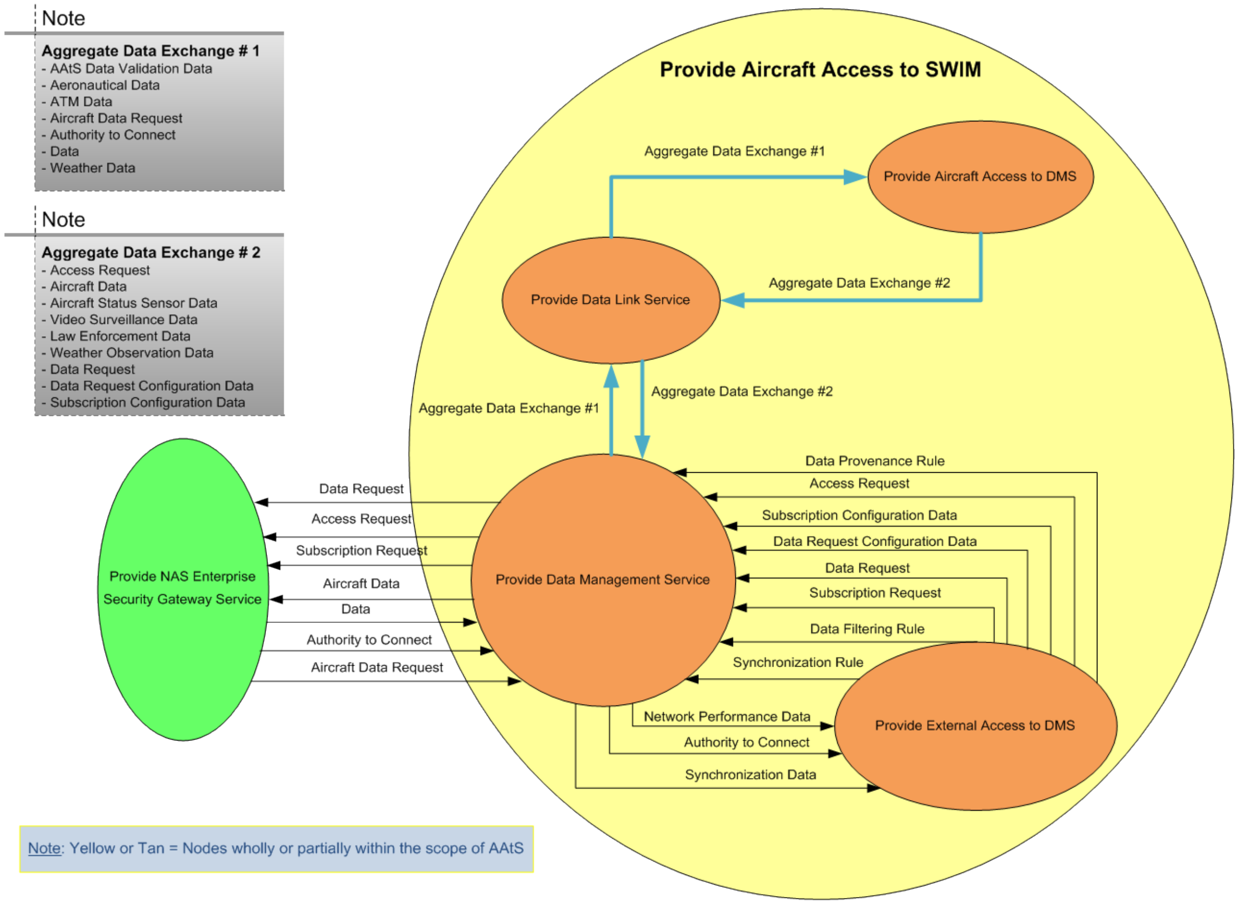


Figure 2-3 – Provide Aircraft Access to SWIM

3.0 IMPLEMENTATION GUIDANCE

The FAA does not, at this time, intend to implement a specific infrastructure to support the actual link to the aircraft but has developed guidance that may be used to drive that infrastructure. As such, the aircraft operator and their designees (e.g., third party DMS provider(s), DLSP (s), etc.) will be implementing the AAtS concepts. As stipulated previously, regardless of the combination of entities involved in the implementation, it is the aircraft operator who will be responsible for attaining operational approval of the capability.

The aircraft operator will either develop and implement the infrastructure needed and described herein or will enter into contractual relationships with other corporate entities. These other corporate entities could already have their operational approval listed in guidance material or may be a new entrant seeking first time approval. In either case, the aircraft operator will use the documented operational and performance characteristics (as detailed in the appropriate test results) achieved by the relevant DMS Providers, DLSPs, and onboard systems to show the regulator that the implemented solution meets the needs of the intended uses. The aircraft operator is responsible for:

- Achieving operational approval(s) and determining the desired DMS, DLS and Aircraft Access to DMS capabilities needed to satisfy the intended use enabled by AAtS concepts. In the case of 14 CFR Part 91 operations, this could be through self-certification
- Including the training and manuals necessary to efficiently and effectively operate or perform duties required within the aircraft
- Establishing a method to monitor the implemented DMS, DLS, and Aircraft Access to DMS capabilities needed to satisfy the intended use

The SWIM and the AAtS initiative promote a paradigm of loosely coupled services where actions in one part of the system can have little or no effect in another to provide a globally interoperable extension of the NAS SOA to aircraft. This paradigm promotes a common shared aviation information environment resulting in global interoperability [6]. The DMS Provider provides the primary functionality needed to manage the flow of data and the connectivity between the DMS, aircraft, DLS, and external access to DMS. Thus, the DMS Provider must:

- Implement the DMS capabilities needed to satisfy the aircraft operator
- Ensure that the DMS is capable of exchanging data with external interfaces in a loosely coupled service oriented manner
- Ensure that testing of the DMS capabilities does not impact operations of any NAS system or SWIM

- Ensure that the DMS uses industry standards for communication protocols, data modeling, security, and software languages for external interfaces to ensure interoperability
- Apply international standards to enable aircraft equipage to connect to data services derived from FAA SWIM-enabled NAS services and other ANSP data sources to allow the SWIM based solution for aircraft connectivity to operate on a global scale

Finally, the DLSP provides the data link (or physical layer) that enables the aircraft to communicate with entities on the ground such as the DMS Provider. Therefore, the DLSP(s) must implement the DLS capabilities needed to satisfy the aircraft operator.

The following sections provide detailed guidance to the process for obtaining access to SWIM-enabled NAS Services for consumption by aircraft. This process includes establishing business and data exchange agreements, implementing and testing AAtS concept capabilities, and finally receiving operational approval from the regulator. It is the responsibility of the aircraft operator to address, detail, and document the specifics of the chosen implementation as it relates to each section of this guidance document.

However, the guidance provided should not be considered as step-wise instructions. While many activities described have direct dependencies and are thusly serial, many are interrelated and should be performed in parallel to each other. It is recommended that the aircraft operator become familiar with all aspects of the guidance and proceed with what is needed for operational approval.

3.1 Establish Business and Data Exchange Agreements

In order for the aircraft to consume data from SWIM-enabled services through the DLS(s), DMS(s) and NESG, certain business and data exchange agreements between these entities are required to establish the connection. This includes:

- The aircraft operator will decide either to implement the DMS capability themselves or establish an agreement with third party vendor(s)
- The DMS provider will establish the network connections to the NESG. This includes the relevant network agreements.
- The DMS provider will establish the NAS enterprise infrastructure service connection(s). This includes the relevant service level agreements (SLA).
- The DMS provider will establish any required DLSP connection(s) and agreements to support the desired capabilities
- The aircraft operator will select the DLSP(s) that supports their desired intended uses

3.1.1 Select the Service Provider(s)

While it may be technically feasible for aircraft to subscribe and subsequently consume SWIM-enabled NAS services directly, the near term reality (due to a variety of policy and business reasons) is for this functionality to be removed from the aircraft. Therefore, it is the responsibility of the aircraft operator to determine who shall implement the intermediary known as the DMS. The aircraft operator must decide to develop and implement the infrastructure needed and described herein or enter into contractual relationships with other corporate entities to do so. Once determined, they must select an appropriate DMS Provider(s) (assuming a third party vendor is selected) and select DLSPs that can or will support their desired intended uses.

3.1.2 Establish the Relevant Connections and Agreements

Once the aircraft operator has selected the DMS provider(s) that will establish the network and service connections to the NESG, the necessary network and service level agreements (SLA) for connection must be established. These connections and agreements have to be established for the aircraft to request and consume data that is exchanged with NAS Data Services through the DLSP, DMS Provider and the compliant connection to SWIM. The implementation process for the network and service connections assumes that the DMS Provider has a method for developing and testing software that produces quality products. For the aircraft to consume SWIM-enabled data, the aircraft operator will establish any required DLSP connection(s) and agreements to support the desired capabilities.

3.1.2.1 DMS to NESG Network Connections

The DMS to NESG network connections describe the processes and agreements involved in obtaining network access to SWIM-enabled NAS Services for aircraft consumption of data. The *FTI Enterprise Security Gateway User's Guide, Volume II – For Non-NAS Users* delineates three possible FTI network connections available to the DMS Providers. These include User-provided Dedicated Transmission Service (DTS) serial interface, User-provided DTS Ethernet, or internet based virtual private network (VPN) connection and are described below.

> **NOTE:** *To ensure efficiency, quality of service (QoS) and provide redundancy, the DMS Provider may select more than one connection method to the NESG.*

> **NOTE:** *For more information on network connections, consult the latest version of the FAA Telecommunications Infrastructure (FTI) Enterprise Security Gateway User's Guide, Volume II – For Non-NAS Users [3].*

For aircraft to consume data from SWIM-enabled NAS services, the DMS Provider must connect/attach to the gateway using one or more of the methods for external users as described below:

1. ***DTS – Serial Interface* -** This method allows a DMS Provider to provide a dedicated circuit and attach it to the external interface of an Enterprise Security Gateway. In order to provision a circuit up to an Enterprise Security Gateway, the following information will be provided upon request to the DMS Provider:
    - E911 address of the gateway
    - Building and room number of the digital demark
    - Local point of contact for installation logistics

    If the DMS Provider uses this method, then the DMS will implement IPSec on all DTS-Serial interfaces.

2. ***DTS – Ethernet Interface* -** This method allows a DMS Provider to attach to an Enterprise Security Gateway with a LAN based ethernet connection. This method is suitable for external users with an established point of presence physically collocated with an FAA security gateway (example: user has an installed network router). The gateway provides a standard ethernet switch to accommodate local LAN connections. Connections between the DMS Provider and the security gateway are secured using VPN based on IPSec.

    > **NOTE:** *For more information, consult the latest version of the FTI Enterprise Security Gateway User's Guide [3]*.

    If the DMS Provider uses this method, then the DMS will implement IPSec on all DTS-Ethernet interfaces.

3. ***Internet-Based* –** This method utilizes the public internet as a transport mechanism. Connections between the DMS Provider and an Enterprise Security Gateway are secured using Virtual Private Networking based on the IPSec protocol. In this connection model, the FAA provides the public internet connection for the security gateway via an FAA managed Internet Access Point (IAP). This enables an external connection mechanism with no external user equipment at the FAA facility.

    If the DMS Provider uses this method, then the DMS implements IPSec VPN on all IAP interfaces, complies with VPN technical requirements, and satisfies the VPN equipment compatibility in the *FTI Enterprise Security Gateway User's Guide, Volume II – For Non-NAS Users*.

Network Connection Process

The process for establishing a network connection to SWIM via the NESG includes three phases: connection planning and design, interoperability testing, and network implementation. The steps to be completed in each phase are excerpted from *NAS Enterprise Security Gateway Users Guide Volume II – for Non-NAS Users [3]* and are further illustrated in Figure 3-1.

Phase – 1: Network Connection Planning and Design

1. The DMS Provider contacts the AAtS Project Officer to request a network connection.
2. The AAtS Project Officer conducts a kick-off meeting with the NAS Sponsor Program, TSG and DMS Provider to discuss:
   - Required service flows and associated connectivity requirements
   - Decision to proceed with extranet service provisioning
   - Roles and Responsibilities
3. The AAtS Project Officer coordinates the execution of the required network agreements and shares technical information with the DMS Provider.
4. The DMS Provider coordinates through the AAtS Project Officer to select the preferred method(s) for attaching to an Enterprise Security Gateway.
5. The DMS Provider completes and returns all network documents required by the AAtS Project Officer.
6. The DMS Provider and TSG coordinate through the AAtS Project Officer to:
   a. verify extranet VPN equipment compatibility with Enterprise Security Gateway.
   b. exchange IP addressing information necessary to configure the access
   c. allow the application to connect to the NESG.

Phase – 2: Network Interoperability Testing

The DMS Provider and TSG coordinate through the AAtS Project Officer to establish test connectivity to the Enterprise Security Gateway in the FTI National Test Bed (FNTB) and perform a series of interface and application testing to validate application performance and the overall operational concepts. Due to the interdependency with the consuming application being available for testing, see section 3.2.2 for further details.

Phase – 3: Network Implementation

The TSG and DMS Provider implement the selected connection method(s) and the AAtS Project Officer coordinates the process to obtain network connection approval from the NAS Data Release Board, TSG, SWIM governance and other FAA governance bodies. Due to the interdependency with the consuming application being available for implementation, see section 3.2.2 for further details.

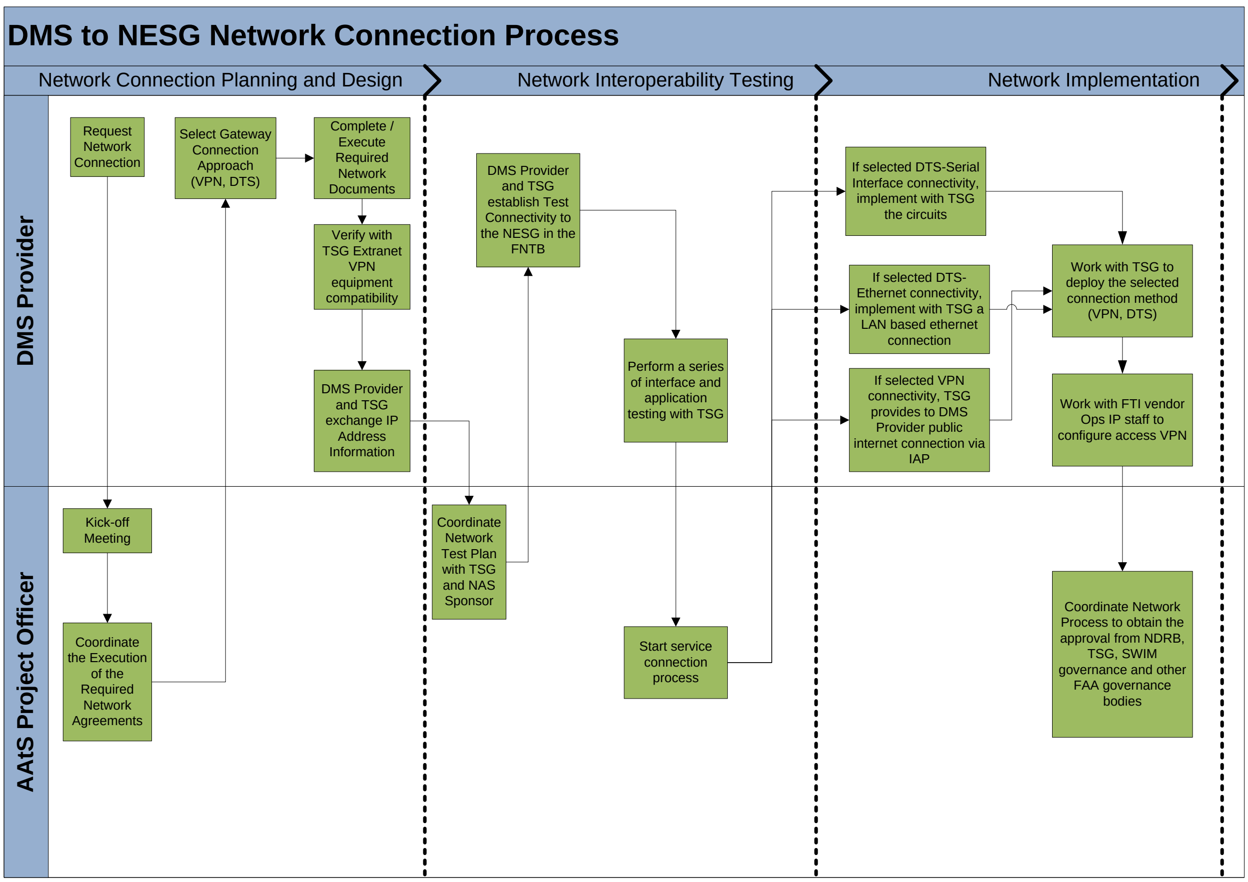


Figure 3-1 – DMS to NESG Network Connection Process

3.1.2.2 DMS to Aircraft Network Connection

A DMS connection to the aircraft has to be established for the aircraft to request and consume data. The DMS connection to aircraft uses an implementation specific physical to transport layer connection. This connection needs to be capable of supporting the required performance necessary to support the intended use. The DLSP(s) provides that wireless data link (DLS) that enables the aircraft to communicate with the DMS Provider. As described elsewhere, multiple DLSPs may be selected depending on the operational environments and performance characteristics needed to support the intended use. Certain functionalities in the DMS, if implemented, will require the DMS to perform some portion of the data link management. The

DMS provider, in conjunction with the aircraft operator, will establish any required DLSP connection(s) and agreements to support the desired capabilities. For further information on these and other capabilities, refer to section 3.2.1.1.

3.1.2.3 Service Registration and Connections

The service registration and connections guidance describe how data services and users are registered and how data services are discovered using the NSRR and how to obtain access to these data services. It leverages the SWIM provisioning process to ensure compliance with FAA policy.

3.1.2.3.1 DMS to NESG Service Registration

This section describes the processes and standards involved in discovering and registering services using the NSRR. The NSRR stores meta-information related to services as well as the relationships between those services. Service meta-information includes several types of data, including a service description, classifications such as protocol types, service category, and delivery channels, and access information such as Web Service Definition Language (WSDL) files and endpoints. The NSRR provides two basic functions – a registry and a repository of services. Based on the information provided in the *SWIM NAS Service Registry/Repository Service Provider User's Manual* [5], the following process has been derived.

Steps to Register as a Consumer in the NSRR

The DMS Provider will use the NSRR to discover services. In order to access and navigate the NSRR user interface to use the NSRR searching and browsing features, the NSRR requires all users to have a username and password. To request an account, follow these steps:

1. The DMS Provider contacts the AAtS Project Officer to register as a consumer in the NSRR.
2. The DMS Provider completes the NSRR Account Request Form (ARF) that can be found at: http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/atc_comms_services/swim/documentation/media/compliancy/NSRR%20User%20Acct%20Request%20Form.doc
3. After successfully filling out the NSRR ARF, the DMS Provider gives the ARF to the AAtS Project Officer to forward to the NSRR Governance Lead.
4. When approved, the DMS Provider will receive an email from the NSRR Administrations team with user credentials attached
5. The DMS Provider accesses the NSRR at https://swimrep.faa.gov/soa

The DMS Provider will use the NSRR to discover all NAS services and must follow the steps to register as a consumer provided in the *SWIM NAS Service Registry/Repository Service Provider User's Manual* [5].

Steps to Register for Consumption of a Service

The DMS Provider will use the NSRR to register for services. As described in *SWIM NAS Service Registry/Repository Service Provider User's Manual* [5], to consume a business service provided by a Service Provider, perform the following:

1. The DMS Provider contacts the AAtS Project Officer for the consumption of a service
2. The DMS Provider logs in to NSRR and navigates to the service that he/she is interested in consuming.
3. From the Toolbar at the top of the Business Service, the DMS Provider clicks Consumption **-->** New Request. The New Consumption Request page opens.
4. The DMS Provider selects Business Service from the list of Service Consumer NSRR artifact types, and then clicks the Next button to open the Select Consumer Artifact page.
5. The DMS Provider selects the consuming Business Service from the list. If necessary, use the Filter button to search for the consuming service.
6. The DMS Provider clicks the Next button to open the Select Service Level Objective (SLO) page.
7. If necessary, the DMS Provider clicks the Select Specific SLO button to view the list of available SLO.
8. The DMS Provider selects an SLO for the consumption request, and then clicks the Next button. The Notification SLO ensures that you will receive notifications of meta-information updates, but does not constitute an agreement between you as a consumer and the Service Provider to actually consume the service.
9. If desired, the DMS Provider edits the name and description of the consumption request, and then clicks the Next button.
10. The DMS Provider reviews the request details, and clicks the Finish button to place the request.

> **NOTE:** *Consult the latest version of SWIM NAS Service Registry/Repository Service Provider User's Manual* [5] *to consume a business service.*

3.1.2.3.2 DMS to Aircraft Service Registration and Connections

The aircraft operator requests specific information from the DMS to support defined intended uses. If that information is available via SWIM-enabled NAS data services, then the DMS

Provider begins service registration and consumption process described in section 3.1.2.3.1. This is assumed at this point to be a manual individual service consumption and not a dynamic UDDI registration/consumption process as may be possible in the future as the NSRR evolves.

The service architecture description contained herein describing the connection between the DMS and the aircraft is considered notional. Further description and standardization can be found in the relevant implementations and in specific industry standards; however, there needs to be a delineation of SWIM-enabled NAS derived services from other potential sources (e.g., NAS non-SWIM, commercial or other). If the data requested by the aircraft is not available via SWIM services then the DMS either: a) is not capable of delivering the information requested, or b) obtains the necessary data from non-SWIM sources. It should be noted that in the case of option "b", while this data may be delivered on the same infrastructure and architecture described in this document, delivering option "b" is considered out of scope of this guidance document.

3.1.2.3.3 DMS to NESG Service Connections

This section describes the processes and agreements involved in consuming services by linking the DMS to and exchanging data with SWIM-enabled NAS Programs. As described in the NSRR user's guide [5], a service contains all of the information that a potential service consumer needs to discover and evaluate whether the service provides the functionality that the service consumer requires. These services also contain all of the information needed to construct a client, including interface description documentation such as a Web Services Description Language (WSDL), reference implementations, and access information. The DMS Provider must ensure that DMS complies with the relevant interface documents or equivalent in the SWIM Service Registry / Repository.

Service Connections Process

The process for establishing a service connection to SWIM via the NESG includes three phases: connection planning and design, interoperability testing, and service implementation. This process assumes the availability of a network connection. The steps to be completed in each phase are excerpted from *NAS Enterprise Security Gateway Users Guide Volume II – for Non-NAS Users* [3] and are further illustrated in Figure 3-2

> **NOTE:** *For more information, please consult the latest version of the users guide*.

Phase – 1: Service Connection Planning and Design

1. The DMS Provider contacts the AAtS Project Officer to request a service connection.

2. The AAtS Project Officer conducts kick-off meeting with the NAS Sponsor Program, TSG, and DMS Provider to discuss:
   - Required service flows and associated connectivity requirements
   - Decision to proceed with extranet service provisioning
   - Roles and Responsibilities
   - Development of a service connection request
3. The AAtS Project Officer coordinates the execution of the required agreements and shares technical information with the DMS Provider.
4. The DMS Provider completes and returns program request for service, creates a Memorandum of Agreement (MOA), and/or other documentation as required by the AAtS Project Officer.
5. The DMS Provider, TSG and SWIM governance coordinate through the AAtS Project Officer to configure the access and allow the consumer to connect to the service through the NESG to include the following activities:
   - Develop service request data for both end-state services and interoperability tests
   - Document testing service data in a FNTB Connection Request Form and IP Supplemental Form
   - Document operational service data in the Ops IP Connection Request Form and IP Supplemental Form

Phase – 2: Service Interoperability Testing

The DMS Provider and TSG coordinate through the AAtS Project Officer to establish a test service connection to the Enterprise Security Gateway in the FNTB and perform a series of interface and application testing to validate service performance and the overall operational concepts (e.g., failover scenarios). Due to the interdependency with the consuming application being available for implementation, please see section 3.2.2 for detailed steps.

Phase – 3: Service Implementation

The AAtS Project Officer coordinates with the DMS Provider service connection's approval from the NAS Data Release Board, TSG, SWIM governance and other FAA governance bodies and the FTI vendor Ops IP staff will perform the in-service cutover. Due to the interdependency with the consuming application being available for implementation, please section 3.2.2 for detailed steps and further details.

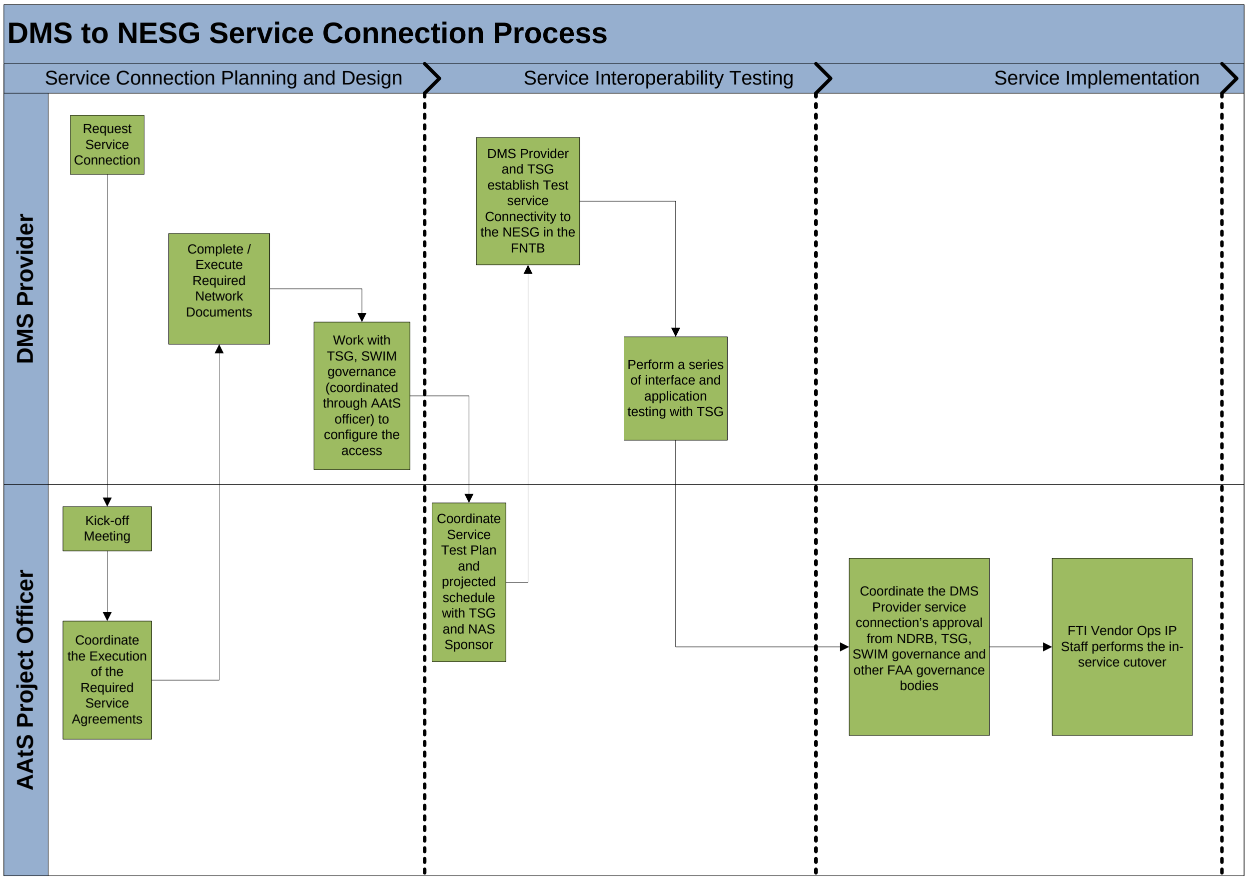


Figure 3-2 – Service Connections Consumer Process

3.2 Implement and Test AAtS Concept Capabilities

The aircraft operator identifies and documents the intended uses that the AAtS capability will support. This identification will drive what functions will be implemented into the capability or what functions will be purchased to support that particular implementation. Additionally, the identified intended uses will drive what the eventual performance characteristics of the final implemented solution will need to operate at. Once identified, the functions are allocated to the relevant implementing entity. The high level functionalities previously described include providing DMS services, providing the aircraft access to DMS services, providing the data link services, and providing external access to the DMS. The various entities implement the desired functions, perform NESG network and service testing, and finally the DMS to aircraft test and evaluation is performed. It is the responsibility of the aircraft operator to show compliance and show documentation of the results to achieve operational approval from AFS. The following subsections show in detail the implementation and testing of AAtS concept capabilities.

3.2.1 Develop AAtS Concept Capability Functionality

The actual allocation of functionality to physical systems is an implementation choice and one best left in the hands of the industry that will be delivering this capability. As such the following is a discussion of functions only. The physical architecture that will house these functions may be allocated significantly different from implementation to implementation. The following list of examples should not be considered comprehensive, but is included to illustrate the flexibility of the proposed functions:

- The DMS functionality may be accomplished by multiple physical and corporate entities forming a data and function chain in the delivery of NAS services to aircraft
- An AOC may elect to retain a portion of the DMS functionality, but contract out other portions
- A selected DLSP may wish to have more control of their systems and enters into an agreement to provide the management of all DLS(s) within the implemented solution
- An FOC may wish to retain a portion of the External Access to DMS functionality and place the remainder on the onboard client

While not all functions will need to be specifically implemented, each function described in this document and illustrated in Figure 2-3 needs to be addressed to the relevant AVS office for approval. Additionally, for those functions that are to be included in an implemented solution, a description of how that functionality is being accomplished and what intended uses are supported by that function is necessary. For example:

- A flight department operating under 14 CFR Part 91K implements a solution for Category 2 services – it is decided that this solution will not implement the data synchronization portion of the External Access to DMS functionality. While it is not required to implement this solution, due to its inclusion in this document, a brief description of why this functionality is not in the solution should be provided.

The following subsections apply to specific functions and end-to-end functions. Several of the sections specifically deal with higher subsetted functions such as the DMS and the DLS, while other sections describe functionality that must be present throughout the entire implemented solution such as security and system performance.

3.2.1.1 DMS Functionality

The DMS provides the primary functionality needed to manage the flow of data and the connectivity between the NESG, Aircraft Access to DMS, DLS, and External Access to DMS. It includes managing communications, the application of technical rules, and other various sub-functions. The DMS functionality binds the aircraft to NAS services while maintaining a loosely coupled solution. The DMS is the coordinating function, the managing function and the monitoring function. In short, the AAtS concept requires the DMS functionality to only implement those subsetted functions based upon intended use.

To avoid performance degradation and ensure correct operation between the DMS and Aircraft Access to DMS, accurate time synchronization between the two is critical. Without synchronized time, accurately correlating log files between these two systems is difficult.

Figure 3-3 illustrates the sub-functions and data exchanges of the DMS functionality.

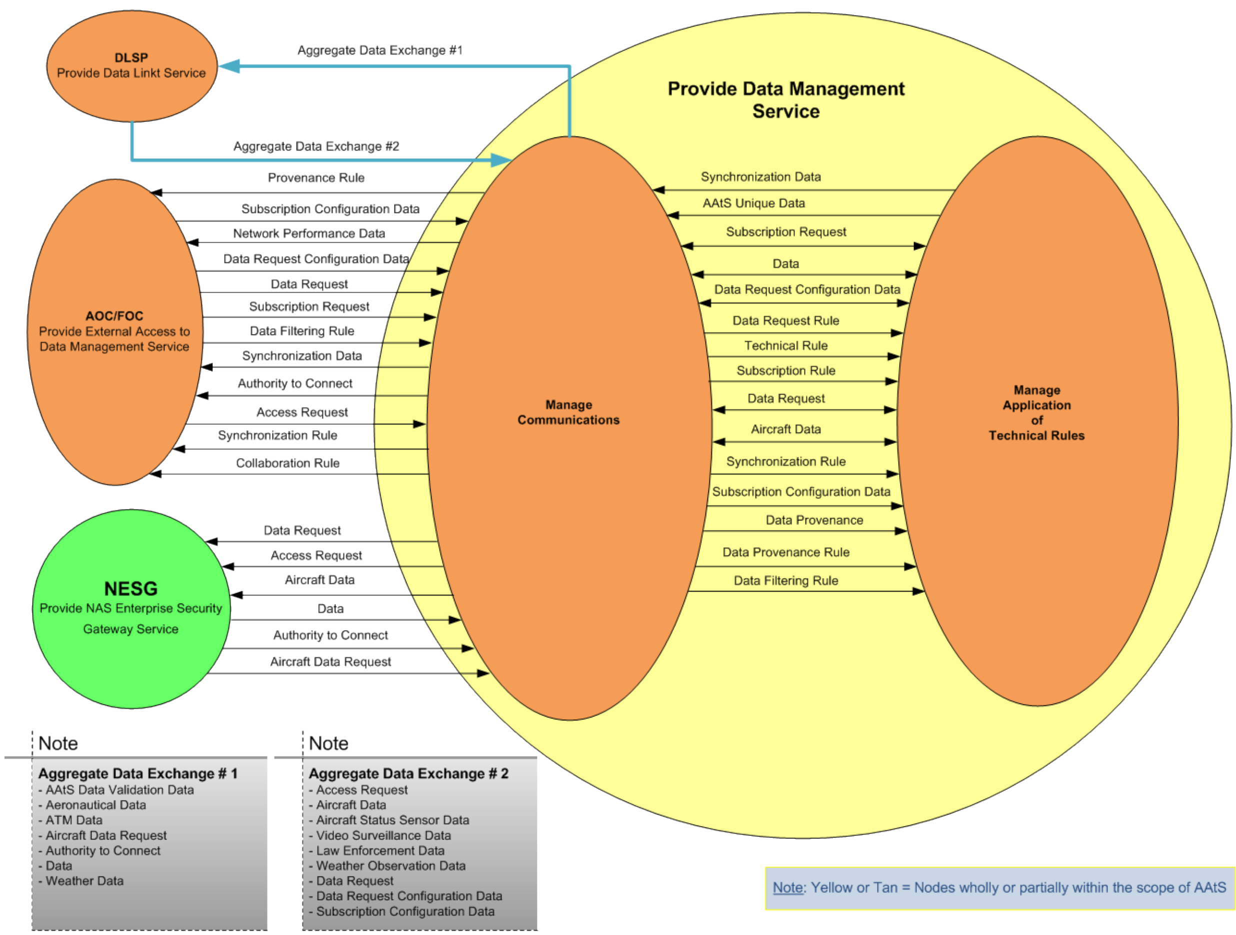
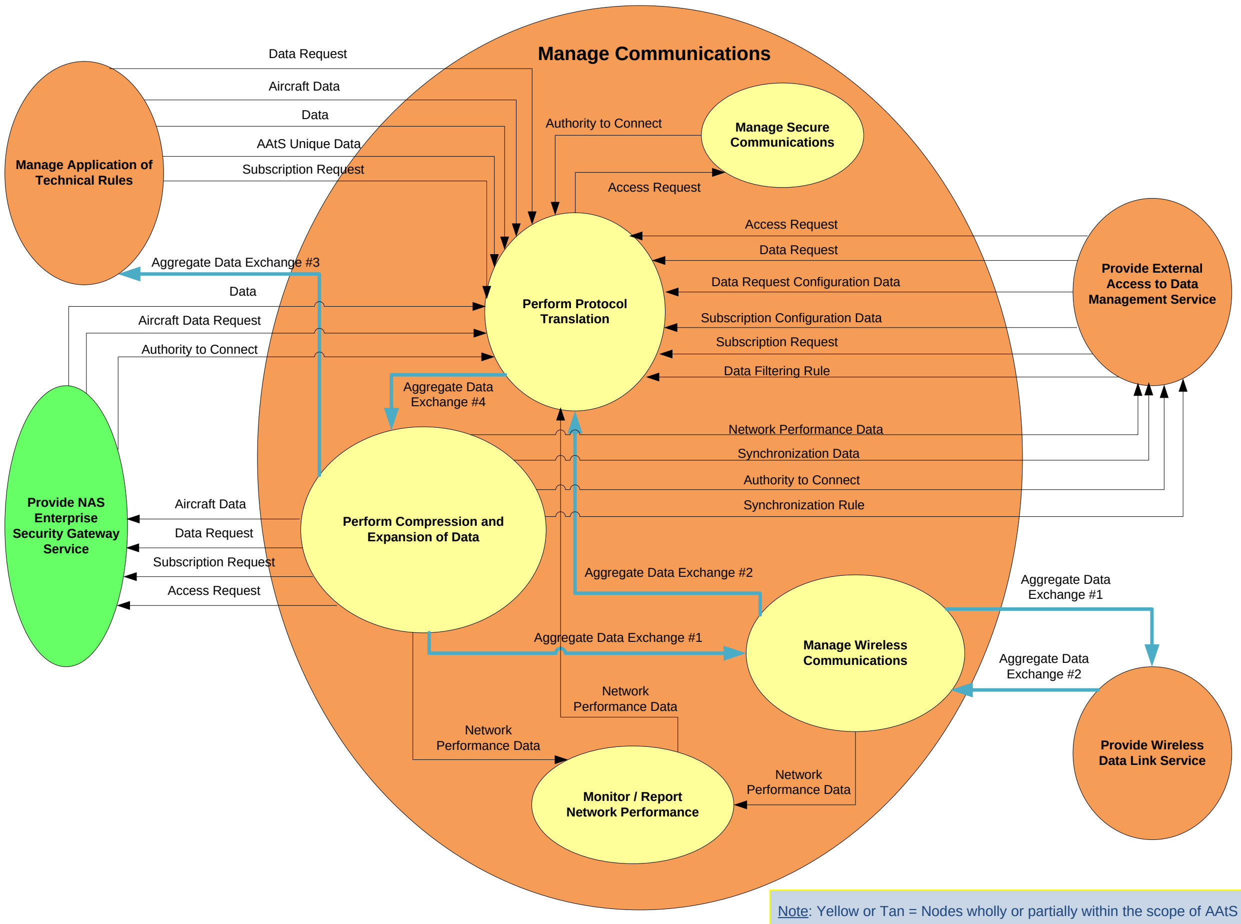


Figure 3-3 – Provide Data Management Service

The following DMS functions need to be addressed by the aircraft operator when they seek operational approval.

3.2.1.1.1 Manage Communications

Figure 3-4 depicts the set of functions managed by the DMS. The DMS manages the connections to the aircraft, the NESG and the External Access to DMS. This management includes data link and session connections and transitions among multiple communications media. Additionally, this functionality performs any necessary protocol translations and compression / expansion of data to satisfy the proprietary solutions and performance characteristics.



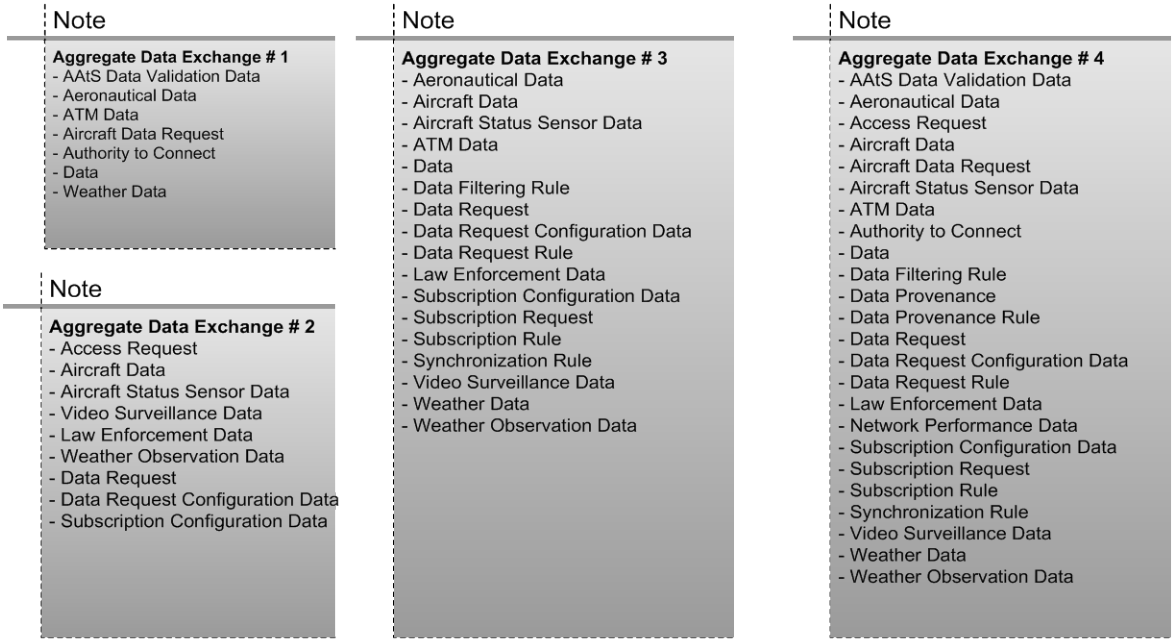


Figure 3-4 – Manage Communications Functions

3.2.1.1.1.1 Manage Secure Communications and Service

The DMS will manage the secure communications and service by enforcing service and message security policies, verifying identities and digital signatures and providing authorization-based access. The DMS will consider the security options described in section 3.2.1.5.

3.2.1.1.1.2 Perform Protocol Translation

There are a variety of proprietary solutions that may be adapted from existing standards today that a DMS implementer may choose to employ to communicate with the onboard client. Additionally, while the intention is for solutions to be standards based, there are a great many disparate standards. The AAtS concept does not intend to specify which standard shall be employed other than to say that any interaction with the NESG or other non-DMS related services shall be done in a decoupled service oriented fashion. The reason for this is to promote interoperability on a global level. Any interaction with the NESG shall be done in a SWIM compliant fashion as well (for further information on protocols associated with SWIM compliance, refer to the SWIM Governance Policies [12] and the SWIM Service Compliance Requirements [16]). With this in mind, the DMS may need to transform one protocol to another (e.g., Java Messaging Service to an XML document or HTTP/HTTPS to AMQP and vice versa).

3.2.1.1.1.3 Compression and Expansion of Data

The aircraft inherently operates in a bandwidth restricted environment and some implementations will choose to use the available bandwidth more efficiently by using compression techniques both going to and coming from the aircraft. Of course, not all compression techniques are created equal and any technique employed will be subject to processing limitations on both ends.

3.2.1.1.1.4 Monitor / Report Network Performance

To provide ongoing assurance to support the intended use, certain intended uses will require that the service have the ability to externally monitor service level performance. This monitoring may even have the ability to alert both the pilot and ground personnel (if appropriate based on operating environment) during degraded operations. As such, the DMS needs to have the ability to monitor the number of errors that occur in the data validation function and network as well as overall system performance metrics. The specific parameters that may be captured as part of this monitoring function can be found in section 3.2.1.5.

Additionally, the aircraft requires that certain metadata tags be set in order to support validity, security, and provenance through semi-independent checks onboard the aircraft. Much of the function of reporting the performance of the system acts as an input into this tagging function. Other aspects can be found in sections 3.2.1.1.2.2, 3.2.1.1.2.6, and 3.2.1.5.

3.2.1.1.1.5 Manage Wireless Communications

Managing the connections to the aircraft can be a complex task with a variety of facets that need to be addressed. Figure 3-5 below illustrates the various sub-functions and their relationships and data exchanges with associated functions.

The DMS may manage the physical connections to the aircraft including management of transitions and connections among multiple communications media (i.e., multiple DLSs). In order to facilitate this graceful transition and session switch, this may include:

- Knowing where the aircraft is – This knowledge may or may not be exchanged with the DMS by interaction with the AAtS onboard client. This could be realized through a variety of different ways (e.g., separate Aircraft Situation Display to Industry (ASDI) data feed to the DMS; aircraft data bus tap from flight management function (FMF) exchanged as a “heartbeat” message from the aircraft; and proprietary data link location services fed to the DMS, etc.).
- Knowing which data links are available – This is achieved through close collaboration between the aircraft operator and the DMS Provider. In many cases, this information may not be available to the DMS.
- Using the best route for data – assuming multiple links are available, determining which is the most efficient. This is closely related to achieving target end-to-end latency.

- Making the connections to achieve the target end-to-end latency and availability to support the intended use.

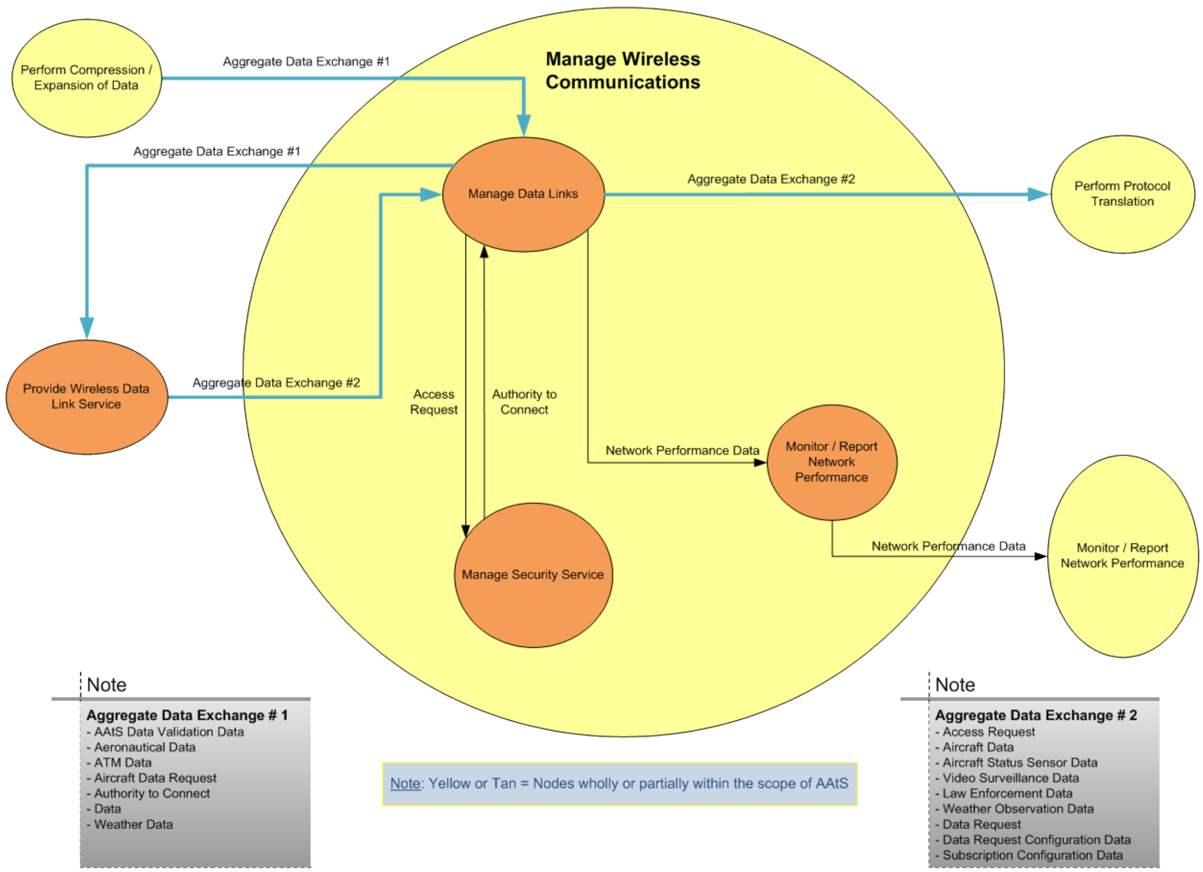


Figure 3-5 – Manage Wireless Communications by DMS

As part of managing these ground-to-aircraft wireless networks, this function will have an inherent knowledge of the level of performance that is being achieved. An additional sub-function is to provide the necessary output to the Monitor / Report Network Performance function.

Lastly, managing an aircraft's wireless access to the DMS is a critical security concern. Man-in-the-middle, spoofing and other options are widely used by hackers of various ideological bents. The last sub-function within Manage Wireless Communication function is Manage the Security Service which maintains secure communications with the aircraft by enforcing service and message security policies; verifying identities and digital signatures; and providing authorization-based access. For further information about how the DMS or the capability as a whole needs to manage security, see section 3.2.1.5.

3.2.1.1.2 Manage Applications of Technical Rules

The DMS requires a function that manages the complex and varied algorithms, rules, and data sets that describe the specific parameters of the overall AAtS solution. It includes data synchronization rules, data validation rules, data filtering initial settings and general operating rules, initial subscription and data request configurations, data provenance, and population of priority and security data fields.

3.2.1.1.2.1 Maintain Data Synchronization between Ground and Aircraft Users

The purpose of data synchronization is to ensure that the External Access to DMS receives the appropriate and relevant information that is being sent to the aircraft from the DMS. Business rules will determine whether this external user receives all data that is sent to the aircraft or whether it will only be notified that a class of data has been sent. These business rules are established by the individual implementation and through the External Access to DMS function (section 3.2.1.3). The Pilot-In-Command and the dispatcher are jointly responsible in operations that fall under 14 CFR Part 121 Air Carrier Certification. An important aspect of satisfying this requirement is the ability to share information to ensure both are making well-informed decisions. In an AAtS environment, this may be interpreted as ensuring that each is aware of the data that is being shared with the other party. The following examples are for illustrative purposes only and should not be considered as the only means of satisfying this function:

- The DMS sends copies to the external user of all data sent to the aircraft for the purpose of allowing ground personnel to remain synchronized with the data being delivered to the aircraft. This creates a complete common situational environment; however, it is very load intensive.
- The DMS sends the type or class of data sent to the aircraft to the external user with sufficient information to enable the external user to request the data. This could be implemented by sending unique "hash tag-like" metadata to the external user of all the data sent to the aircraft.
- The DMS should send copies to the external user of selected types or classes of data sent to the aircraft. This example enables the external user to subscribe to copies of the data sent to the aircraft for discrete sets of data or data products, e.g., NOTAMs or weather.

3.2.1.1.2.2 Perform Data Validation

Information used in flight operations need to have a certain assurance of quality and accuracy. Without that assurance the flight crew and systems cannot rely on the information being provided to make relevant and safe decisions and calculations. While important to any eventual operational approval, the quality of the information being delivered by SWIM-enabled NAS services to the NESG is not within the scope of AAtS. What is within the scope is that the information being delivered to the NESG is delivered to the aircraft with the same quality. Additionally, there are realistic checks using quality mechanisms which can flag certain data errors for the flight crew’s attention. The Data Validation function is intended to describe the metadata that is required to communicate the validity, timeliness, and continuity of data to an aircraft. The data provided by DMS will be used, in conjunction with other information, by pilots to make decisions that affect the safety of flight. The DMS may consider the options outlined in Table 3-1 for performing data validation.

Metric	Definition(s)	Behavior
Timeliness #1	Data is delivered within its valid timeframe	• DMS software evaluates message content for start and end date/times to determine whether the message data needs to be flagged when sent to the aircraft or presented to the user. • Software will enable the user to set a parameter for acceptable range of variance from valid time frame for transmitting information to the aircraft. • Software sets the Data Validation element appropriate valid time frame code: Within valid time frame; Outside valid time frame • Software maintains percent of failures and reports via the Monitor/Report Network Performance function as a percent per 1,000 messages: 1,000 minus # of out-of-valid time frame messages **Divided by** 1,000
Timeliness #2	Data represents the most up-to-date information	• DMS software tracks and reference all updates using the time they are issued (regardless of the effective time(s) of the changes) until the time of reception to identify the most up-to-date information. • DMS software transmits new or updated information to the cockpit as soon as it becomes available at the approved source. • User will be enabled to set a parameter for acceptable range of variance from time for transmitting information to the aircraft as measured from the issue date/time of the message until received. • DMS software populates the Data Validation element code with appropriate timeliness factor code: Meets timeliness factor; Exceeds timeliness factor • The network performance metric is defined as communications performance for transmission of information from the data source to the cockpit. This performance metric will be defined by intended function and operational use. • Software determines whether messages meet currency time frame requirement as measured from issue date / time through delivery date / time to aircraft. Software will maintain percent of failures and report via the Monitor/Report Network Performance function: 1,000 minus # of messages not meeting time frame **Divided by** 1,000

Metric	Definition(s)	Behavior
Timeliness #3	Subscribed update intervals are being complied with	• Software monitors update intervals to ensure they are being complied with using transmission date time groups (DTGs) as the criteria for determining the actual intervals. • Software populates the AAtS Data Validation Data element code with appropriate timeliness factor code: Meets subscribed interval; Exceeds subscribed interval • User will be enabled to set a parameter for acceptable range of variance from subscribed update intervals. This is represented in the formula below as "*X*" • Software maintains percent of failures and reports via the Monitor/Report Network Performance function: 1,000 minus # of subscription intervals missed by more than *X* seconds **Divided by** 1,000
Lost Data – applies to all modes of operation – broadcast mode, demand mode, and contract mode	Determine whether any messages or data sets were lost	• DMS software evaluates **message content and context** to determine that a message has been lost, e.g., refers to prior content such as NOTAM, TFR that has not been received, and populates the lost data code in the AAtS Data Validation Data Set. • Software populates the AAtS Data Validation Data element code with appropriate lost data code: No lost data; Previous message not received • Software evaluates the frequency at which a message refers to prior content (e.g., NOTAM, SIGMET, TFR, etc.) that has not been received. Software maintains percent of failures and reports via the Monitor/Report Network Performance function: 1,000 minus # of lost messages/data sets **Divided by** 1,000

Table 3-1 – Data Validation Rules for DMS

3.2.1.1.2.3 Perform Data Filtering

In a bandwidth limited operational environment such as the one in which aircraft operate, it is not feasible or economical to send the entirety of what is subscribed to by the DMS. The purpose of this data filtering function is to pare down the incoming data stream into the specific data needed for a specific situation or use. Additionally, there are situations where data must be restricted from flowing to a specific user, e.g., data with redistribution restrictions or proprietary data. It is anticipated that the data filtering profiles will be maintained by the DMS and by the External Access to DMS function and uploaded to the onboard client in consideration of aircrew workload. The DMS may consider the outlined options in Table 3-2 for performing the data filtering.

Configuration Options	Context / Description / Rationale
By message type or class of data	Align with the Message Types from Populate Priority and Security Data Fields
By issue time for types for data–range of parameters	Range of parameters associated with the Message Types
By effective time for types of data – range of parameters	Range of parameters associated with the Message Types
If multiple values are available, enable selection of average value, standard deviation value, range of values, preferred provider(s)	For example, if multiple sensor sources are available and provided for an area, enable the user to select a means to reduce the data to a relevant value, e.g., multiple temperature sensors at an airport.
Enable selection or input of a specific geo-reference for sensor data	For example, user might select RVR for the eastern-most of two parallel runways because the swamp outside the airport tends to produce mist that reduces visibility for that runway.
By expiration time – range of parameters	Range of parameters associated with the Message Types
Enable selection of any data within a geo-referenced area, e.g. X miles either side of route and including vertical range for a 3-D area	The AOC can set this based on a pilot profile and can upload to the EFB. This geo-referenced area can also be pilot-selectable.
Enable selection of "Trend" for a specific event	This rule allows an operator to select a data point, e.g. weather event, and indicate how much history of the event is desired for a trending display.
Enable no filtering at all	In the case of a DMS to DMS transfer of data, the entire data set would be transmitted.
Filter on security level code	The security code populated in the Populate Priority and Security Data Fields section is used to ensure that appropriate data safeguards are imposed on the data received by the aircraft or the DMS.

Table 3-2 – Data Filtering Options

3.2.1.1.2.4 Manage Subscription and Data Request Configurations

The DMS manages configuration parameters used to establish and modify subscriptions and recurring data requests. The DMS may consider the outlined options in Table 3-3 for performing the subscription and data request configurations.

System Rule	Context / Description / Rationale
DMS systems contain configurable profiles for subscriptions and data requests that are managed by both the aircrew and the dispatcher	Subscriptions have a couple of characteristics that impact AAtS: • They publish a complete stream of data. • They publish updates to a data set. In the latter case, the subscriber must perform a data request to ensure it has a current copy of the complete data set that can then be updated. The profiles associated with this system rule enable the user to designate which subscriptions require a "pre-load" of the complete data set and then to request that data.
Configuration profiles shall be capable of alignment with specific flight plans.	Configuration profiles will be used repetitively for common routes.
Users shall be able to store profiles keyed at least to flight or route and pilot.	Configuration profiles will be used repetitively for common routes and pilots may have specific needs for specific data or different parameters, e.g., miles to either side of the route.
Configuration profiles shall enable the user to plan deviations from a flight plan or establish ad hoc situations for obtaining needed flight planning information.	As part of both pre-flight and en route strategic planning, dispatchers will need to be able to push updates and changes to the onboard client that supports these planning activities.
Update interval timeframes shall be configurable by subscription, e.g., NAS program or other source of data	The user will establish update intervals that support his or her need for frequency of data.
Request-response configurations shall be enabled for those subscriptions that require a pre-load of the data when updates only are issued with the subscription	Data request-response configurations are important because in many instances activation of a subscription only provides updates. In those instances, activation of the subscription must also be accompanied for a data request to pre-load a baseline of the data.
User shall be able to select data sets that are not on the flight plan, e.g., select specific items or events, or expand the geospatial scope of the subscription.	As part of both pre-flight and en route strategic planning, dispatchers and pilots will need to be obtain data that support these planning activities.
Subscription parameters associated with a configuration profile shall be capable of being downloaded to an onboard client.	In consideration of aircrew workload, subscription profiles need to be pre-loaded into the onboard client.

Table 3-3 – Subscription and Data Request Configurations for the DMS

3.2.1.1.2.5 Populate Priority and Security Data Fields

Information needs to be developed and transmitted as metadata to enable "downstream systems" to provide information to the aircraft on the importance and priorities of messages, data re-distribution limitations, and service level agreements associated with communication technologies. In a bandwidth-restricted environment, it is important to identify messages that have greater priority based on their importance and type. The DMS may consider the outlined options in Table 3-4 for populating the priority and security data fields.

Title	System Rules	Context / Description / Rationale
Message Importance / Priority	High-importance and short-to-expire messages shall be sent before low-importance and long-to-expire messages. Software shall evaluate message content to determine its priority and populate the appropriate field in the AAtS Data Validation Data Set • Evaluate expiration time for less than specified number of minutes • Evaluate by Message Type to set priority • Evaluate by request priority to set delivery priority	In a bandwidth-restricted environment, it is important to identify messages that have greater priority based on their importance and type.
Message Type	Software shall determine type or class of message from the header information or content and assign appropriate code. Reference for examples of these types of information can be found in Appendix C of DO-340 [9]	In order to support the Message Importance / Priority metric, the types of messages need to be defined.
Security Level	• Software shall determine how data may be used, displayed, or retransmitted based on the terms of the data exchange agreement with the data provider Software shall populate a security code in the appropriate field in the AAtS Data Validation Data set as noted in the following examples: • Encryption required • Company proprietary • Limited data redistribution • Classified – Secret • etc.	The data provider may impose restrictions on the use and redistribution of data, aviation operators may impose limitations on distribution and use of their data and the operational environment may require additional security restrictions. This field may be populated by either the DMS or the aircraft: • DMS to accommodate the terms of its data distribution agreements or the need to safeguard company proprietary data • Aircraft primarily to safeguard company proprietary data being sent from the aircraft to the DMS and potentially to a NAS program.
Data Link SLA	DMS software shall determine the data link that is being used to transmit the message and populate the field as noted in the following examples: • Vendor SLA1 • Vendor SLA2 • Vendor SLAn Vendor SLA1 through n – indicates the established performance associated with specific transmission technologies that are being used to transmit data to and from the aircraft.	This code expresses the terms of the data link type that is associated with a specific message and represents the SLA level for the reliability, consistence, validity, etc. metrics. This is a function of the technology and the associated SLA that is used for transmitting the message.

Table 3-4 – Priority and Security Data Field Rules

3.2.1.1.2.6 Perform Data Provenance

Data Provenance is an area that studies the evolution of data, including the source and authority of data creation; changes to the data along the life history of the data; and the sources responsible in achieving those changes. It provides a qualitative and quantitative metric to analyze the quality and the dependability of the data, based on the consumer's trust of the source of creation and the sources that were responsible for modification. The DMS may consider the outlined options in Table 3-5 for performing data provenance.

System Rules	Context / Description / Rationale
The DMS software includes metadata describing the authoritativeness of the source in messages sent to the aircraft	This allows the onboard Aircraft Access to DMS software to make intelligent decisions about how the data is presented to the flight crew or used by other aircraft systems (i.e., if the data is not sourced with authority, inform the crew in some manner or quarantine it from use by onboard systems).
The DMS software provides a mechanism for recording provenance data.	There is a need for historical recall of data and metadata sent and received from aircraft for many purposes (e.g., accident investigation).
The DMS Provider shall establish a method for secure provenance between the NESG and the aircraft.	This ensures all points on the length of the AAtS data exchange can trust that the data received continues to have integrity (i.e., lack of corruption intentional or accidental). Additionally this ensures that when there is a breakdown in integrity, it can be identified where it occurred. In this instance secure provenance refers to providing integrity and confidentiality guarantees to information requiring provenance. In other words, secure provenance means to ensure that the data cannot be altered, and users can trace who else has performed actions on the data.
The DMS Provider shall enable operators to configure what type or class of information will have provenance associated with it.	In a bandwidth intensive environment some operators may elect to conserve bandwidth by limiting the types and classes of data that has provenance associated with it. It should be noted that some types and classes of data may eventually become required by regulation for security and safety purposes.

Table 3-5 – Data Provenance Rules

3.2.1.2 Aircraft Access to DMS Functionality

This is the integrated function that receives and processes for display or use in the cockpit the DMS delivered SWIM-enabled NAS services. The Aircraft Access to DMS functionality is on board the aircraft and could be physically represented by a variety of aircraft equipage that for the purposes of this document, are referred to as the onboard client. This function manages the flow of data and the connectivity between the Data Management Service and user applications on board the aircraft. Additionally, it maintains secure communications, subscription and data request configurations, validates the data, and performs a data acquisition service from aircraft systems and sensors.

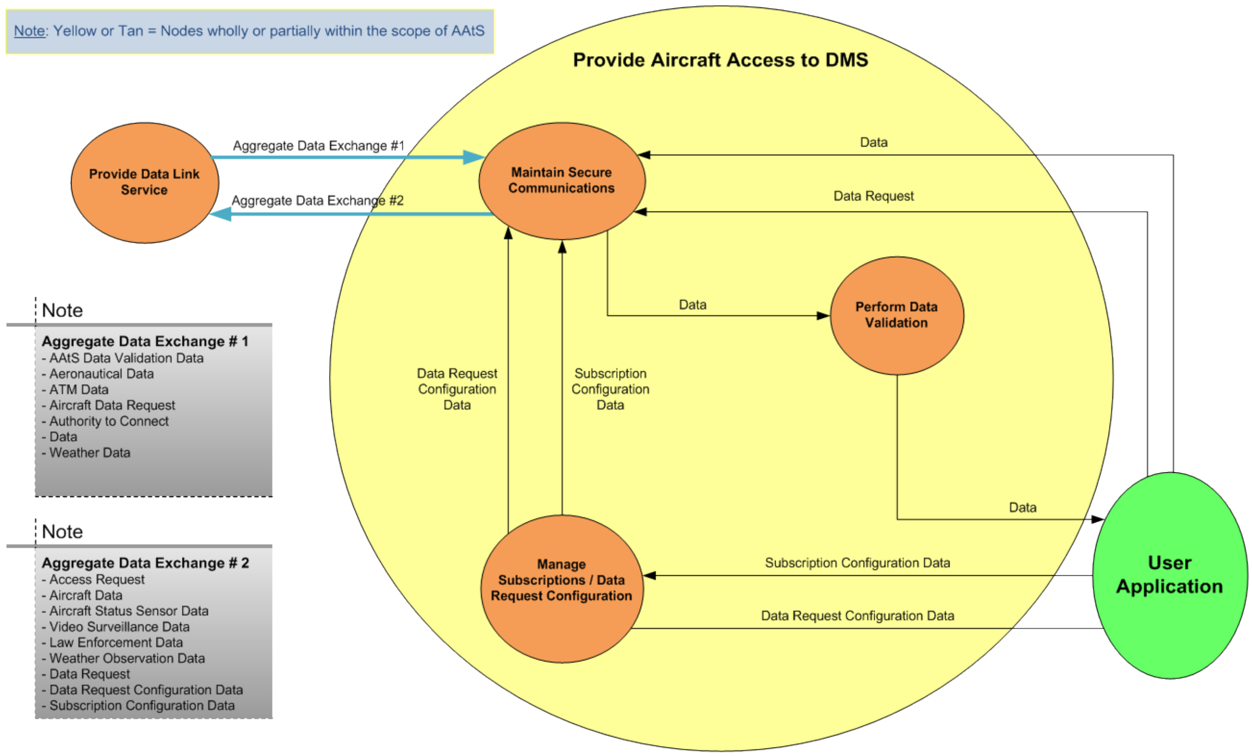


Figure 3-6 – Provide Aircraft Access to DMS

The following aircraft system functions need to be addressed by the aircraft operator when they seek operational approval.

3.2.1.2.1 Maintain Secure Communications

The Aircraft Access to DMS maintains secure communications by enforcing service and message security policies, verifying identities and digital signatures, and providing authorization-based access. Maintaining secure communications is one of the core security functions which are addressed in section 3.2.1.5.

3.2.1.2.2 Manage Subscription and Data Request Configurations

The crew or other onboard user of NAS data establishes requests for various pieces of aviation information. The onboard client maintains a function which manages configuration parameters used to establish and modify subscriptions and recurring data requests. This function manages the configuration of the business rules that govern what data will be subscribed to. The Aircraft Access to DMS may consider the outlined options in Table 3-6 for maintaining subscription and data request configurations.

System Rule	Context / Description / Rationale
The Onboard client contains configurable profiles for subscriptions and data requests that are managed by both the aircrew and the dispatcher	Subscriptions have a couple of characteristics that impact AAtS: • They publish a complete stream of data. • They publish updates to a data set. In the latter case, the subscriber must perform a data request to ensure it has a current copy of the complete data set that can then be updated. The profiles associated with this system rule enable the user to designate which subscriptions require a “pre-load” of the complete data set and then to request that data.
Configuration profiles shall be capable of alignment with specific flight plans.	Configuration profiles will be used repetitively for common routes.
Users shall be able to store profiles keyed at least to flight or route and pilot.	Configuration profiles will be used repetitively for common routes and pilots may have specific needs for specific data or different parameters, e.g., miles to either side of the route.
Configuration profiles shall enable the user to plan deviations from a flight plan or establish ad hoc situations for obtaining needed flight planning information.	As part of both pre-flight and en route strategic planning, dispatchers and pilots will need to be obtain data that support these planning activities.
Update interval timeframes shall be configurable by subscription, e.g., NAS program or other source of data	The user will establish update intervals that support his or her need for frequency of data.
Request-response configurations shall be enabled for those subscriptions that require a pre-load of the data when updates only are issued with the subscription	Data request-response configurations are important because in many instances activation of a subscription only provides updates. In those instances, activation of the subscription must also be accompanied for a data request to pre-load a baseline of the data.
User shall be able to select data sets that are not on the flight plan, e.g., select specific items or events, or expand the geospatial scope of the subscription.	As part of both pre-flight and en route strategic planning, pilots will need to obtain data that support these planning activities.
Subscription parameters associated with a configuration profile shall be capable of being downloaded to an onboard client.	In consideration of aircrew workload, subscription profiles need to be pre-loaded into the onboard client.

Table 3-6 – Subscription and Data Request Configurations for the Aircraft Access to DMS

3.2.1.2.3 Perform Data Validation

Much of this function is accomplished by reading the validation codes set by the DMS. This function is where the onboard client extracts the validation metadata and evaluates the results against the current environment. Data validation describes the messages that are required to communicate the validity, timeliness, and continuity of data to an aircraft. The data provided by the DMS will be used, in conjunction with other information, by pilots to make decisions in support of the intended use. For further information on data validation refer to section 3.2.1.1.2.2. The Aircraft Access to DMS may consider the options outlined in Table 3-7 for performing data validation.

Metric	Definition(s)	Behavior
Timeliness #1	Data is delivered within its valid timeframe	• Software on the onboard client evaluates message content for start and end date/times to determine whether the message data needs to be flagged when sent to the aircraft or presented to the user. This identifies messages that are within valid time frame when transmitted but not when received at the aircraft. • Software shall enable the user to set a parameter for acceptable range of variance from valid time frame for transmitting information to the aircraft. • Software shall maintain percent of failures and reports via the Monitor/Report Network Performance function as a percent per 1,000 messages: 1,000 minus # of out-of-valid time frame messages **Divided by** 1,000
Timeliness #2	Data represents the most up-to-date information	• The Onboard client software references the timeliness factor set by the DMS and either discards or appropriately flags the data depending on the intended use. • The network performance metric shall be defined as communications performance for transmission of information from the data source to the cockpit. This performance metric will be defined by intended function and operational use. • Software shall determine whether messages meet currency time frame requirement as measured from issue date / time through delivery date / time to aircraft. Software shall maintain percent of failures and report via the Monitor/Report Network Performance function: 1,000 minus # of messages not meeting time frame **Divided by** 1,000
Timeliness #3	Subscribed update intervals are being complied with	• Software shall monitor update intervals to ensure they are being complied with using transmission date time groups (DTGs) as the criteria for determining the actual intervals. • User shall be enabled to set a parameter for acceptable range of variance from subscribed update intervals. This is represented in the formula below as "*X*" • Software maintains percent of failures and reports via the Monitor/Report Network Performance function: 1,000 minus # of subscription intervals missed by more than X seconds **Divided by** 1,000

Metric	Definition(s)	Behavior
Lost Data – applies to all modes of operation – broadcast mode, demand mode, and contract mode	Determine whether any messages or data sets were lost	• The onboard client software references the Lost Data factor set by the DMS and either discards or appropriately flags the data depending on the intended use. • Software shall evaluate the frequency at which a message refers to prior content (e.g., NOTAM, SIGMET, TFR, etc.) that has not been received. Software maintains percent of failures and reports via the Monitor/Report Network Performance function: 1,000 minus # of lost messages/data sets **Divided by** 1,000

Table 3-7 – Data Validation Rules Aircraft

3.2.1.3 External Access to DMS Functionality

In an effort to decouple the configuration of the parameters and rule sets associated with the behavior of how the DMS delivers information to the aircraft and to ensure compliance with certain operating rules, the External Access to DMS functionality was defined as the "portal" to manage the capabilities of the DMS for the aircraft operator. This function enables external entities, e.g., AOC, FOC, to connect to the Data Management Service and to manage configurations for functions such as business rules, data filters, and subscriptions. As mentioned previously, there are many possible physical ways to represent this functionality. No one way is more correct than the other assuming the implemented functions meet the needs of the intended use.

Figure 3-7 illustrates the functional relationships and data interactions between the DMS and a human user. It is worth noting that this human user is an abstract representation and can be embodied by more than one user in substantially different locations using significantly different systems.

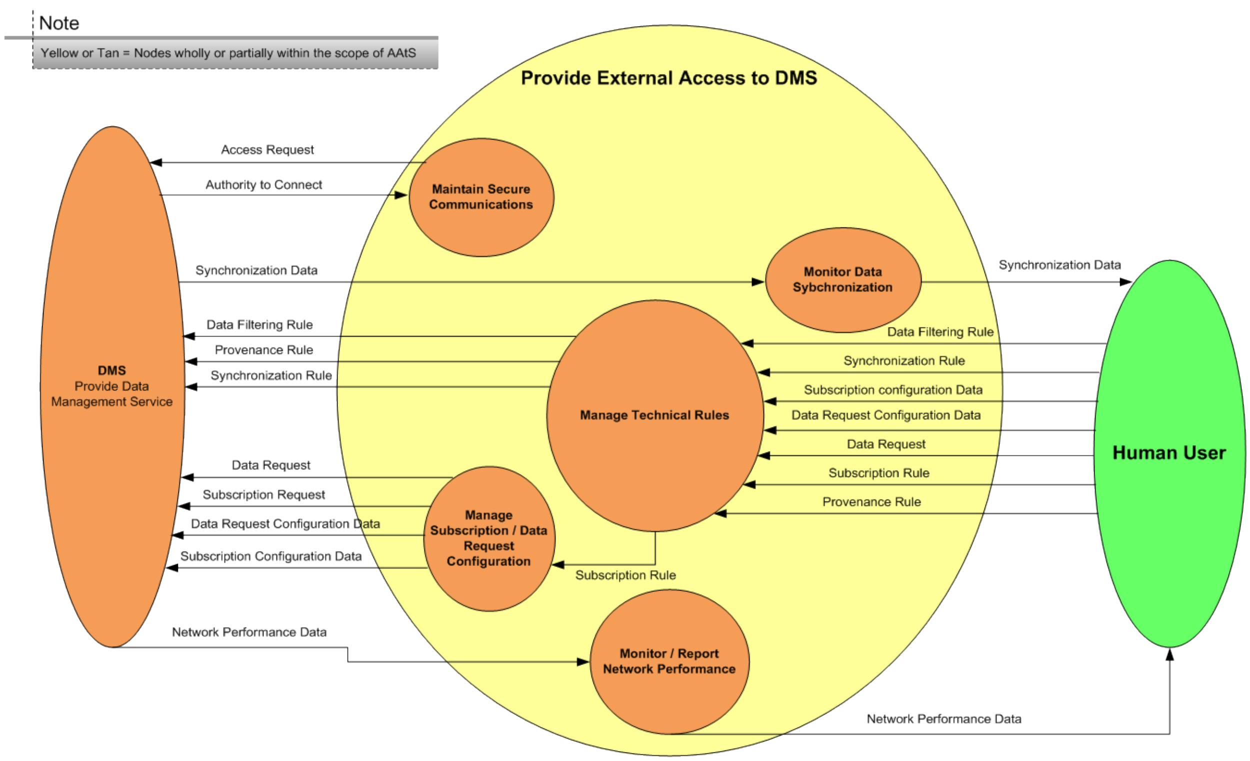


Figure 3-7 – Provide External Access to DMS

Largely this function can be broken into two groups of sub-functions and one ancillary function. There are monitoring and managing functions as well as a function which allows secure communications with the DMS.

The following External Access to DMS functions need to be addressed by the aircraft operator when they seek operational approval.

3.2.1.3.1 External Access to SWIM Monitoring (Network Performance / Data Synchronization)

This sub-function satisfies the needs of the human user or established automation to ensure that the capability is performing as expected and to be alerted when its performance drops below what is expected. This function monitors the numbers of errors that are reported by the DMS that occur in the data validation function and provides performance parametric outputs to the user.

Additionally, this provides the ability for the human user to monitor the data that is exchanged between the aircraft and the DMS. As previously described, the joint safety responsibility between the pilot-in-command (PIC) and the dispatcher in a 14 CFR Part 121 operation is the primary driver for this function. Some non-121 air operators may wish to implement this solution; however, this is not required by any known set of guidance or regulatory documentation. For example, some 14 CFR Part 135 air operators manage their day-to-day business practices in near identical ways as their 14 CFR Part 121 brethren.

> **NOTE:** *It is the scope of this document to define the means to allow aircraft to access the common data platform realized through SWIM and also to provide a synchronization means with the AOC. The functions necessary to connect ATM to the common source are outside the scope of this document.*

3.2.1.3.2 External Access to DMS Managing

The user is able to set a variety of rules and configuration options that will dictate a large portion of how the DMS delivers data to aircraft and how data is monitored. The various parameters and rules that the user is able to set are:

- Data filtering rules – A rule to filter specific classes of data. For example, if an aircraft requests temperature data for an airport, it generally desires a single aggregate value or a single sensor value versus all the data from multiple sensors.
- Synchronization rules – A business rule that governs how the external entity will be kept informed of the data that is sent to the aircraft
- Subscription rules – A business rule that drives the configuration and frequency of a subscription
- Provenance rules – A business rule that governs how data provenance shall be managed by the DMS

- Subscription configuration data – Data that configures the business rules that drive subscriptions in a service-oriented environment. From this data, further External Access to DMS functionality derives:
    - Subscription Request – A request for a subscription to data published by a service
- Data request configuration data – Data that configures the business rules that drive data requests in a service-oriented environment. From this data further External Access to DMS functionality derives:
    - Data Request – A request for information that is both requested and delivered in a machine-readable format

For more specifics on how these rules are applied within the DMS and Aircraft Access to DMS functionality, see sections 3.2.1.1.2 and 3.2.1.2 respectively.

3.2.1.3.3 Maintain Secure Communications

This function maintains secure communications with the DMS by enforcing service and message security policies, verifying identities and digital signatures, and providing authorization-based access. The implementer of this function will consider the security options described in section 3.2.1.5.

3.2.1.4 DLS Functionality

The data link service can be comprised of multiple physical links which are provided by multiple providers. The DLS is critical to the realization of the AAtS concepts as without the ground to aircraft connection, none of these data exchanges occur. This function needs to satisfy the:

- delivery technologies, protocols and standards of the implemented solution interactions between the DMS and the Aircraft Access to DMS functions.
- specifics of the Manage Wireless Communication functions of the implemented solution (section 3.2.1.1.1.5)
- allocated performance characteristics for a minimum AAtS capability as well as any of those associated with the specific end-to-end needs of the intended use (section 3.2.1.6)

3.2.1.5 AAtS Security

This section describes the security aspects needed to support any AAtS implemented solution. Security is multi-faceted and ever changing. When technologies are developed to counter security threats, these technologies are quickly compromised. One can take the approach that the most secure connection is the one without a connection; however, that approach does not lead to collaborative exchanges needed to fulfill NextGen’s goals. One can never design an aircraft engine that never breaks. To apply that axiom to IT security, it would be unrealistic to believe that an information system can never be compromised. What is needed is a pragmatic, standards based approach using accepted practices that describe general governing processes that assure a continued level of security as technology evolves.

This section describes the processes and standards involved in satisfying the security requirements for obtaining access to SWIM-enabled NAS Programs for consumption of data by the aircraft as well as the security aspects that have to be established for the aircraft to consume data that is exchanged with NAS Data Services through the DLS, DMS and the compliant connection to SWIM. There are two overarching FAA orders which apply, due to the connection with the NESG, to the entire AAtS solution implementation. The AAtS solution implementation must apply FAA JO 1370.98 ATO Information Technology (IT) Infrastructure Requirements for Non-FAA Connectivity, April 2007 (or current version) and FAA JO 1370.99 ATO NAS Information Systems Security Patch Management, April 2007 to satisfy the intended functional use.

3.2.1.5.1 Security Between DMS and NESG

The NESG supports the establishment of connections between NAS systems and external systems. The NESG services extend the NAS Operational IP network into an “extranet” over non-FAA transport resources (such as the Internet or Dedicated Transmission Services - DTSs). The gateway makes use of IP Security (IPSec) controls, such as VPNs, to create authorized connections between external systems and the NESG. External connectivity to NAS systems requires that an external system establish an IPSec compliant VPN tunnel to the external interface of the FAA NESG. The security requirements can vary by NAS program, depending upon the sensitivity of the data. Complete detail for a specific NAS program is provided in the MOA and/or service level ICDs or WSDLs as developed by the sponsoring NAS system for external users.

As described in the *FTI Enterprise Security Gateway User’s Guide for Non-NAS users* [3], the following are considered standard practice in the establishment of security controls for isolating processes that will connect to a NAS system via an FAA Enterprise Security Gateway:

1. DMS is required to install security controls to protect any application processing environment that interfaces to a NAS system via extranet services. The objective of DMS system security controls is to isolate the external processes, access devices and the associated external service interface from other external systems and un-trusted user access.
2. DMS security controls are required to have the following properties:
   - Established and documented security policies
     - Demonstrated adherence to all security policies.

  - Security policy must allow only approved traffic flows.
  - Security policy must be granular enough to specify filtering based on source IP address, destination IP address, and ports.
- Security controls must protect the application environment and associated access device that implements the user-side of the NAS Service Delivery Point (SDP).
  - Security controls and access device must either be on the same platform, or
  - Security controls must be between the access device and the Internet.
- Security controls must maintain logs that store data necessary to analyze a potential attack.
  - Logs must show detailed data on connection attempts and VPN negotiations.
  - Logs must be made available to FAA upon request.
- Security controls must employ minimum firewall functionality such as stateful inspection.
- Client hosts (i.e., platforms for the external application processes and access device) participating in the access VPN must be protected from unauthorized access and Internet attack.

3. The DMS Provider must run the VPN and security control software on a machine that runs a secured and hardened operating system.
4. The DMS Provider must maintain the remote end access VPN security control and additional firewall operating system software at a currently supported version and apply all appropriate system and security patches.

3.2.1.5.2 Security Between DMS, External Access to DMS, and Aircraft

The Aircraft Access to DMS, DMS, DLS, and External Access to DMS maintain secure communications by enforcing service and message security policies, verifying identities and digital signatures and providing authorization-based access. The implemented service may consider the following options in implementing security:

- Enforce service and message policies
- Verify identities and digital signatures
- Provide authorization-based access

The data provider may impose restrictions on the use and redistribution of data, aviation operators may impose limitations on distribution and use of their data and the operational environment may require additional security restrictions. This field may be populated by the DMS to accommodate the terms of its data distribution agreements or the need to safeguard company proprietary data.

Ultimately, it is the responsibility of the aircraft operator to address how the DMS Provider will implement security and population of a security code in the appropriate field in the AAtS Data Validation Data Set as noted in the following examples:

- Encryption required
- Company proprietary
- Limited data redistribution
- Classified – secret

3.2.1.6 AAtS Performance

The performance requirements define the operational and technical performance parameters that the DMS, DLS, and Aircraft Access to DMS functions need to achieve to connect aircraft to SWIM and interact with SWIM-enabled NAS services. These parameters include availability, integrity and transaction time. It should be noted and stressed that these are baseline performance parameters for the mere establishment of an AAtS concept based solution. The following discussion of AAtS performance does not include specific attention to the intended use of the information derived from SWIM-enabled NAS services. The performance attributes and characteristics can be found in other guidance material and industry standards.

AAtS describes an interaction between the SWIM-enabled NAS services and the aircraft using a variety of connections, systems and networks. The performance characteristics between the entry into the NAS system and the exit from the SDP within the NESG are not within the scope of AAtS and are described elsewhere. These data exchanges pass through many out of scope elements such as the processing by that NAS service, the transmission and protocol handling of the messages from that service by SWIM, the enterprise boundary layer passage and any protocol processing that may be required at the SDP. The description of the performance of those services and systems will be described in the NSRR as well as the MOAs and SLAs that the DMS establishes with the NAS services.

3.2.1.6.1 Availability

Availability is a measure of how often a system's resources and services are accessible to end users, often expressed as the *uptime* of a system. Availability is a way to specify the *uptime* of a deployed system. It is typically measured as the percentage of time that the system is accessible to users. The time the system is not accessible (*downtime*) can be due to the failure of hardware, software, the network, or any other factor that causes the system to be down. In most cases, scheduled time for service (maintenance and upgrades) is not considered downtime.

The NAS Requirements 2025 document describes the availability of routine NAS services and service threads. It has been determined that AAtS concept based solutions (e.g., DMS, DLS, and Aircraft Access to DMS) and AAtS service threads delivered to aircraft need to meet the minimum availability of .99.

3.2.1.6.2 Integrity

Integrity is defined as the probability that communication transactions completed within the transaction time are without detected errors. Integrity is ensured by determining that there are no messages or data sets were lost or corrupted during the transmission of data. While data integrity is of vital importance to safe operations, the individual implementations may or may not include integrity guidance based on the intended uses. Furthermore, the aircraft operator may impose higher stringent parameters based on individual need. ICAO document 9869 *Manual on Required Communication Performance (RCP), dated 2008* [15] describes a minimum of 10^{-5} per flight hour integrity value for all RCP values. Thus, it has been determined that for those items described in section 3.2.1.1.2.2 of this document the DMS may not provide out of valid data or data sets more than 10^{-5} per flight hour to achieve Category 1 services. Category 2 services remain unaffected by this integrity guideline as they are not intended to support ATS functions. The AC 20-149 for broadcast mode and AC 20-140A for demand and contract modes define loss of data and corrupt data for Category 2 services are minor failure conditions.

3.2.1.6.3 Transaction Time

ICAO document 9869 [15] defines communication transaction as the maximum time for the completion of the operational communication transaction after which the initiator should revert to an alternate procedure. Within this definition is the concept of operational communication transaction. This document further defines an operational communication transaction as the process that a human uses to send or receive information. The AAtS concept is centered on the data exchange and as such transaction time in this document refers to system performance only. It is described as the interval in which a system communication action is initiated until the action is complete. Transaction time is characterized in seconds.

Document 9869 provides a wide range of communication transaction times ranging from 10 seconds to 400 seconds. The following guidance is intended to establish a base value only and does not include the performance characteristics of the intended uses. Therefore, it has been determined that the DMS will ensure that the data exchange between the NESG SDP and the output of the Aircraft Access to DMS function is within a transaction time of 400 seconds to support Category 1 services. Category 2 services remain unaffected by this transaction time guideline as they are not intended to support ATS functions.

3.2.2 Perform AAtS Solution Testing and Evaluation

As with any system that is to be used onboard aircraft and in an operational environment where the potential to affect the safety flight exist, one must adequately test that the end-to-end service behaves appropriately. Specifically:

- The end-to-end service operates with all functions linked together and behaves as functionally described and determined by design requirements by the specific solution implementation

  NOTE: *Intended uses requiring a Hazard level greater than a Level E or "No Effect" will require that the requirement development and assurance process for the software of the various components follow certain aviation standards defined elsewhere (e.g., DO-178C and/or DO-278A)*

- The systems security behaves as expected within the accepted practices specified for the AAtS solution implementation
- The performance characteristics of the AAtS solution implementation meet or exceed those specified in this guidance document
- The performance characteristics of the AAtS solution implementation meet or exceed those required to support the intended uses

There are a number of other non-data exchange level functions that will require attention and documentation (e.g., human factors, display symbology, etc.) that are not discussed in this guidance document. AAtS is a data exchange concept and as such remain within the scope of this document.

3.2.2.1 Perform NESG Network & Service Testing and Implementation

The network and service testing and implementation have to be established to obtain network and service access to SWIM-enabled NAS services for consumption of data by the aircraft. Thus, the DMS Provider(s) must perform NESG network connection and NAS enterprise infrastructure service connection(s) interoperability testing and implementation.

The following subsections describe the steps needed to achieve network and service interoperability testing and implementation.

3.2.2.1.1 NESG Network Connection Interoperability Testing and Implementation

Figure 3-1 describes the DMS to NESG network connection process. The steps to be completed in phase 2 and 3 are excerpted from *NAS Enterprise Security Gateway Users Guide Volume II – for Non-NAS Users [3]*.

NOTE: *For more information, please consult the latest version*

Phase – 2: Network Interoperability Testing

The purpose of interoperability testing is **only** to ensure network interoperability between the DMS and NESG.

1. The AAtS Project Officer coordinates test plan and projected schedule with NAS Sponsor program and TSG testing personnel.
2. The DMS Provider and TSG coordinated through AAtS Project Officer to establish test connectivity to the Enterprise Security Gateway in the FNTB (VPNs over internet are also required for testing through the security gateway).
3. The DMS Provider and TSG coordinated through AAtS Project Officer to perform a series of interface and application testing to validate application performance and the overall operational concepts. To accomplish this step, the DMS Provider has already decided to consume at least one service and the service connection process starts (see section 3.1.2.3.3 for the process flow).

Phase – 3: Network Implementation

1. If DTS-Serial Interface connectivity is being used, the TSG and DMS Provider implement the circuits and any planned equipment at the chosen Enterprise Security Gateway location(s).
2. If DTS-Ethernet Interface connectivity is being used, The TSG and DMS Provider to implement a LAN based Ethernet connection.
3. If Internet based-VPN connectivity is being used, the TSG provides to the DMS Provider the public Internet connection via an FAA managed IAP.
4. The DMS Provider works with TSG coordinated through AAtS Project Officer to deploy the selected connection method(s).
5. The DMS Provider works with the FTI Vendor Ops IP staff coordinated through AAtS Project Officer to configure access VPNs between the external system access device and the FAA Enterprise Security Gateway.

6. The AAtS Project Officer coordinates the process to obtain the DMS Provider network connection approval from the NAS Data Release Board (NDRB), TSG, SWIM governance and other FAA governance bodies.

> **NOTE:** *These steps are a deviation from NESG user's guide [3]. The NESG combines the connection of network and services. In order to preserve the concept of decoupled services, the service connections are addressed in section 3.2.2.1.2.*

3.2.2.1.2 NESG Service Connections Interoperability Testing and Implementation

Figure 3-2 describes the DMS to NESG service connection process. The steps to be completed in phase 2 and 3 are excerpted from *NAS Enterprise Security Gateway Users Guide Volume II – for Non-NAS Users [3]*.

> **NOTE:** *For more information, please consult the latest version*

Phase – 2: Service Interoperability Testing

The purpose of this interoperability testing is **only** to ensure service interoperability between the DMS and NESG.

In most cases, it will be necessary to test and/or certify an external system before it is allowed to communicate with any FAA operational (NAS) system. This may be accomplished by connection to a test system. This step is FAA sponsor program dependent and often includes interoperability testing between their test system/application and the external system. The FTI National Test Bed (FNTB) at the William J. Hughes Technical Center (WJHTC) in Atlantic City, NJ supports testing in a fully isolated environment.

The steps to be completed in this phase include:

1. The AAtS Project Officer coordinates test plan and projected schedule with NAS Sponsor program and TSG testing personnel. Support completion of:
    a. Test bed service requests
    b. Sponsor Program IP Supplemental Form
2. The DMS Provider and TSG coordinated through AAtS Project Officer establish a test service connection to the Enterprise Security Gateway in the FNTB.
3. The DMS Provider and TSG coordinated through AAtS Project Officer perform a series of interface and application tests to validate service performance and the overall

operational concepts (e.g. failover scenarios). These concepts must be verified while using the FNTB gateway with all identified security controls active.

Phase – 3: Service Implementation

1. The AAtS Project Officer coordinates the DMS Provider service connection's approval from the NAS Data Release Board (NDRB), TSG, SWIM governance and other FAA governance bodies.
2. FTI Vendor Ops IP staff will perform the in-service cutover after the following items requiring completion are verified:
    - All network connection requirements have been complied with
    - A service connection request must be received; Service Interoperability testing of the envisioned external connections (and all required security controls) at the FNTB must be completed and documented
    - Activation of gateway security controls to support end-to-end data flows requires:
        - Completion, signing and delivery of all required MOA/ISA materials
        - Authorization from WAN enterprise security authority
        - NAS Sponsor Program requires authority to release NAS data (obtained by completing the process defined in FAA Order 1200.22E)
    - External User requires authority to connect to the NAS infrastructure obtained by completion and signing of ISA

    NOTE: *These steps are a deviation from NESG user's guide. The NESG combines the connection of network and services. In order to preserve the concept of decoupled services, the service connections are addressed separately.*

3.2.2.2 Perform DMS to aircraft test and evaluation

Test and Evaluation (T&E) is a major technical risk mitigation measure and needs to be conducted in accordance with industry best practice.

It is the responsibility of the aircraft operator to demonstrate and/or document:

- The integration testing performed prior to the DMS, Aircraft Access to DMS, DLS, and External Access to DMS being delivered to the aircraft operator for operational use (i.e., NESG → DMS → DLS → Aircraft Access to DMS).
- The test methodology employed to satisfy the intended use needed for approval by AVS

- The Test and Evaluation results necessary to satisfy the intended use needed for approval by AVS

3.3 Receive Operational Approval

Ultimately, the individual seeking operational approval for the AAtS solution implementation is the one responsible for providing that which is required. This document assumes that the aircraft operator is that individual. To achieve operational approval by AVS or the relevant approving authority, the aircraft operator needs to show documentation for:

- All the functions described in this guidance with their specific resolutions
- The test and evaluation results

The approval of the AAtS Solution implementation will need to be followed prior to or in parallel with any approval for Category 1 services or uses that are associated with a hazard condition higher than a level E or "No Effect". It is assumed that the architecture used to deliver the AAtS solution implementation may be capable of delivering those types of services assuming that it meets the relevant requirements.

The following subsections focus on submission of Function Resolution Documentation as well as the test and evaluation results documentation.

3.3.1 Submit Functional Resolution Documentation

This documentation must detail the specifics of what intended uses will be supported by what functions in the AAtS solution implementation. As described before, not all functions need to be implemented; however, should a function not be implemented, a brief description of why that function is not relevant to the intended uses is required.

This documentation needs to not only list the functions that are satisfied, but also to provide sufficient detail for AVS to evaluate the efficacy of the proposed solution. The minimum of this response will be a physical architecture with functional allocations to that architecture. Examples of other aspects that should be included are:

- Technology standards employed
- Data models employed

Lastly the aircraft operator must detail the requirements that the solution will be/has been tested to. Additionally, there are certain requirements that must be established by the aircraft operator that are system and not system based and are important to a realized solution. Examples of the types of requirements that must be addressed include, but are not limited to:

- System and performance characteristics that will be tested. These include availability, Integrity, transaction time, data synchronization, data validation, data filtering, subscription and data request configuration, populate priority and security data field, and data provenance requirements.
- Training necessary to efficiently and effectively operate or perform duties required within the aircraft.
- Requirements to establish a method to monitor the AAtS solution implementation capabilities needed to satisfy the intended functional uses.

3.3.2 Submit Test and Evaluation Results Documentation

The aircraft operator needs to show documentation to AVS of their test and evaluation results. This documentation includes:

- NESG network connection interoperability test results
- NESG service connections interoperability test results
- Internal DMS capabilities test results
- Internal Aircraft Access to DMS capabilities test results
- DLS capabilities test results
- External Access to DMS capabilities test results
- AAtS solution implementation capabilities and interoperability test results

> **NOTE:** *Results of requirements testing to satisfy hazard levels higher than a Level E or "No Effect" will require that the requirement development and assurance process for the software of the various components follow certain aviation standards defined elsewhere (e.g., DO-178C and/or DO-278A) and as such that approval process is defined elsewhere.*

It should be noted that this guidance document is not requiring that the aircraft operator perform all of this testing and demonstrations themselves. Much of the functional and performance testing can and will be accomplished by vendors and provided to the aircraft operator that purchases their services. For example, if an airline enters into a contractual relationship with a DLSP to deliver a DLS within the functionality and the performance necessary described herein then this airline should be able to satisfy the DLS individual testing portion by showing documentation provided by the DLSP. Additionally, the AAtS data exchange solution implementation may need evaluation by the Aircraft Evaluation Group.

APPENDIX A – REFERENCES

[1] *NextGen Implementation Plan*, FAA, March 2011.

[2] *AAtS Initial Concept of Use Document with Use Case Scenarios*, Booz Allen Hamilton, March 2012.

[3] *FAA Telecommunications Infrastructure (FTI) Enterprise Security Gateway User's Guide, Volume II – For Non-NAS Users*, Revision 2c, February 2010.

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[5] *SWIM NAS Service Registry/Repository Service Provider User's Manual*, version 1.0, June 2011.

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[7] SESAR 09.19: *High-Level SWIM A-G Architecture and Functional Requirement Specification*, 09.19-D03-00.02.00, August 2011

[8] RTCA/DO-308, *Operational Services and Environment Definition (OSED) for Aeronautical Information Services (AIS) and Meteorological (MET) Data Link Services*, December 2006.

[9] RTCA/DO-340, *Concept of Use for AIS and MET Data Link Services* – September 2012.

[10] *Preliminary AAtS Regulatory Guidance Analysis Report*, Version 1.0, May 2012.

[11] *National Airspace System Requirements Document 2025 (NAS-RD-2025)*, November 2011.

[12] *SWIM Governance Policies*, version 1.1, August 2010.

[13] *SWIM Final Program Requirements for Segment 1, Revision 7.3,* May 2007.

[14] *SWIM Final Program Requirements for Segment 2*, Revision 11.0, January 2012.

[15] ICAO 9869, *Manual on Required Communication Performance (RCP), 2008.*

[16] *SWIM Service Compliance Requirements*, July 2010.

[17] RTCA/DO-324, Safety and Performance Requirements (SPR) for Aeronautical Information Services (AIS) and Meteorological (MET) Data Link Services, December 2010.

[18] FAA Advisory Circular AC120-76B, *Guidelines for the Certification, Airworthiness, and Operational Use of Portable Electronic Flight Bags*, June 12th 2012

[19] FAA Advisory Circular AC91-78, *Use of Class 1 or Class 2 Electronic Flight Bag (EFB), July 7th* 2007.

[20] FAA Advisory Circular AC91-21.1B , *Use of Portable Electronic Devices Aboard Aircraft*, August 25th 2006.

[21] FAA Aeronautical Information Manual, *Official Guide to Basic Flight Information and ATC Procedures*, February 2012. http://www.faa.gov/air_traffic/publications/atpubs/aim/

APPENDIX B – ACRONYMS AND GLOSSARY

Acronyms/Name	Description
AAtS	Aircraft Access to SWIM will provide aircraft with a means to connect to a common collection of aeronautical services provided from multiple sources including the FAA, DHS, airports, and other information services.
AAtS Data Validation Data	A set of data that indicates the quality, timeliness, and validity of messages from NAS data sources.
AAtS solution implementation	The specific implementation with all functions necessary to support the intended uses that the aircraft operator documents to achieve operation approval of the capability
Access Request	A request to connect to a secure system and access data.
Aeronautical Data Service	A service that provides aeronautical information such as notices to airmen, flight restrictions, special use airspace, etc.
Aggregate Data Exchange	A collection of system data exchanges that are aggregated into a single systems data exchange line to improve readability. The aggregate line is typically expanded on the child diagram and/or in a table published with the architecture.
AIR	Aircraft Certification Service offices (AIR) share responsibility for the design and production approval, airworthiness certification, and continued airworthiness programs of all U.S. civil aviation products.
AFS	Flight Standards Service (AFS) Service promotes safe air transportation by setting the standards for certification and oversight of airmen, air operators, air agencies, and designees. We also promote safety of flight of civil aircraft and air commerce by: • Accomplishing certification, inspection, surveillance, investigation, and enforcement • Setting regulations and standards • Managing the system for registration of civil aircraft and all airmen records
Air Traffic Information	Air Traffic information includes, but is not limited to, traffic flow, playbook, traffic management initiatives, terminal movement, and arrival information.
Aircraft	Device(s) that are used or intended to be used for flight in the air, and when used in air traffic control terminology, may include the flight crew [21].

Acronyms/Name	Description
Aircraft Operator	The entity responsible for ensuring the crew is appropriately trained and equipped. Additionally, they have the responsibility to maintain the aircraft and the aircraft systems. This entity is also responsible for interacting with the relevant regulatory bodies to achieve the operational approval to operate the aircraft in the intended environments using expected policies and procedures. Examples include: • Certificate holder in 14 CFR. • Corporate Flight Department in 14 CFR Part 91F or 91K • Pilot in Command (PIC) in 14 CFR Part 91 operations. This PIC must ensure that the systems used meet the needs of the intended use. Relevant guidance for self-certification can be found in: o AC120-76B – *Guidelines for the Certification, Airworthiness, and Operational Use of Electronic Flight Bags (EFB)* [18] o AC91-78 – *Use of Class 1 or Class 2 Electronic Flight Bag (EFB)* [19] o AC91-21.1B – *Use of Portable Electronic Devices Aboard Aircraft* [20] o For integrated installed solutions, the PIC needs to be familiar with and follow the guidance contained in the supplied flight manual(s
Aircraft Access to DMS	These include a variety of onboard systems that may include, but is not limited to, flight management, informational, video surveillance, and sensor systems. These also include all classes of EFBs as defined by AC120-76B and AC91-78.
AMQP	Advanced Message Queuing Protocol
ANSP	Air Navigation Service Provider
AOC	Airline Operations Center
AOC/FOC	The system node that contains the systems used to perform business operations at an Airline Operations Center or Flight Operations Center. System functionality may include, but not be limited to planning, flight following, weather displays, etc.
ARF	Account Request Form
ARTCC	Air Route Traffic Control Center
ATC	Air Traffic Control
ATCSCC	Air Traffic Control System Command Center
ATM	Air Traffic Management
ATM Data Service	ATM data service which provides data such as traffic flow, playbook, traffic management initiatives, terminal movement, and arrival data.
Atmospheric Conditions	The state of the atmosphere in terms of temperature and wind and clouds and precipitation.
Authority to Connect	Authority granted to a system to connect and share data with another system.
AOV	Air Traffic Safety Oversight (AOV) office oversees the Safety Management System (SMS) process in ATO in accordance with FAA Order 1100.161

Acronyms/Name	Description
AVS	Office of Aviation Safety (AVS) - AVS is the FAA organization responsible for establishing certification standards for aircraft, operators, and air carriers. AVS also approves and issues Flight Standards. AVS includes the AOV, which oversees the SMS process in ATO in accordance with FAA Order 1100.161.
Broadcast Mode	A one-way interaction in which AIS and/or MET updates or changes applicable to a designated geographic area are continuously transmitted (or transmitted at periodic intervals) to any aircraft capable of receiving the broadcast within a certain service volume defined by the system network architecture.
Capture Message Error Data	This process step includes derivation of the error rates associated with the validation checks in the Data Validation process in accordance with the technical rules in the Mid-Term Architecture SV-10a.
Contract Mode	A two-way interaction that is an extension of the demand mode. Initial AIS and/or MET information is sent to an aircraft and subsequent updates or changes to the AIS and/or MET information that meet the contract criteria are automatically or manually sent to an aircraft.
Critical Information	Information that directly affects the trajectory of the aircraft. Examples of trajectory affecting information: Aircraft clearances, aircraft instructions, Data exchanges that cause unilateral changes in the aircraft trajectory without further interaction with the relevant Air Traffic Control facility.
Data	A general definition of the information needed by one entity from another that is delivered in machine-readable format.
Data Filtering Rule	A rule to filter specific classes of data. For example, if an aircraft requests temperature data for an airport, it generally desires a single aggregate value or a single sensor value versus all the data from multiple sensors.
Data Link Service Provider	The Data Link Service Provider is the provider of the wireless link from the DMS or other ground station to the aircraft using commercially available technologies.
Data Management Service	The Data Management Service is that set of services that are needed to manage connections between aircraft and the R&D Security Gateway. Additionally, it maintains a number of data sets needed to manage transactions with the Security Gateway, aircraft, and external users.
Data Management Service Provider	The Data Management Service (DMS) provider provides a set of services that are needed to manage connections between aircraft and the NESG. Additionally, it maintains a number of data sets needed to manage transactions with the Security Gateway, aircraft, and external users.
Data Request	A request for information that is both requested and delivered in a machine-readable format.
Data Request Configuration Data	Data that configures the business rules that drive data requests in a service-oriented environment.
Data Request Rule	A business rule that drives the configuration and frequency of a data request.

Acronyms/Name	Description
DCIS	Data Communications Integrated Service – Provides a digital communications service between the pilots/flight deck avionics and controllers/ground automation to exchange safety-of-flight air traffic control (ATC) clearances, instructions, traffic flow management, flight crew requests and reports.
Demand Mode	A two-way interaction in which AIS and/or MET information is transmitted to an aircraft in response to a specific request.
Determine & Populate Data Link SLA Data Element	This process step includes the evaluation of data in accordance with the technical rules defined in the SV-10a and populating the appropriate AAtS Data Validation data element.
DHS	Department of Homeland Security
DLSP	Data Link Service Provider
DMI	Deferred Maintenance Items
DMS	Data Management Service
DMZ	De-Militarized Zones
DTS	Dedicated Transmission Service
EFB	Electronic Flight Bag
Exchange Aviation Information	This activity includes the processes of establishing and managing communications, determining the information that will be subscribed to or requested, and managing the actual exchanges.
FAA	Federal Aviation Administration
FCA	Flow Constrained Area
Flight Planning Information	Flight Planning Information is the collection of attributes associated with scheduling aircraft usage of available airspace capacity and can consist of information integrated from weather information, surveillance information, fixed-object information, and outage notifications. This also includes initial estimates for required fuel load needed for flight routes and aircraft weight and balance information.
FMF	Flight Management Function
FNTB	FTI National Test Bed
FOC	Flight Operations Center
FTI	FAA Telecommunications Infrastructure
GPWS	Ground Proximity Warning System
ICR	Integrated Collaborative Rerouting
IPSec	IP Security
IRD	Integrated Requirements Document
IRD / ICDs, Guidance Materials, Connection Technical Information	Interface Requirements Documents (IRDs), Interface Control Documents (ICDs), Guidance Materials, Connection Technical Materials that are required for an Extranet End User to connect to SWIM.
ISA	Interconnection Security Agreement
ISEF	Integrated Systems Engineering Framework

Acronyms/Name	Description
Maintain Data Synchronization Between Ground and Aircraft Users	This function ensures that the aircraft and the AOC/FOC are aware of the data being sent to the other. Business rules will determine whether the AOC/FOC receives all data that is sent to the aircraft or whether it will only be notified that a class of data has been sent.
Maintain Secure Communications	This function maintains secure communications by enforcing service and message security policies, verifying identities and digital signatures and providing authorization-based access.
Manage Aircraft Access to Data Management Service	This function includes the activities of establishing secure communications, managing communications, performing data validation and providing a user interface.
Manage Application of Technical Rules	This function manages the algorithms and data sets that ensure the aircraft and the AOC/FOC are aware of the data being sent to the other and that the data sent to the aircraft is valid and current.
Manage Communications (including data filtering, validation, and management)	This process manages the wireless connections between the ground and aircraft, including knowing where the aircraft is, knowing which data links are available, calculating the best route for data, making the connections to achieve the target end-to-end latency and availability, and performing filtering and data validation.
Manage Data Filter Configuration	This function manages the configuration of the business rules that govern the data that is allowed to pass to the aircraft or the user.
Manage Data Links	Includes knowing where the aircraft is, knowing which data links are available, calculating the best route for data, and making the connections to achieve the target end-to-end latency and availability.
Manage Secure Data Exchanges	This process maintains secure communications by enforcing service and message security policies, verifying identities and digital signatures and providing authorization-based access.
Manage Security Service	This function maintains secure communications by enforcing service and message security policies, verifying identities and digital signatures and providing authorization-based access.
Manage Subscription / Data Request Rules	This function maintains the rules for the configuration parameters used to establish and modify subscriptions and recurring data requests.
Manage Subscription/Data Request Configuration	This function manages the configuration of the business rules that govern the data that will be subscribed to.
Manage Synchronization Rules	This function maintains the rules that govern how the AOC/FOC will be kept informed of the data that is sent to the aircraft via AAtS.
Manage Technical Rules Configuration	This function manages the configuration of the business rules that support decisions and which data is shared.
Manage Wireless Communications	This function manages the physical connections to the aircraft including management of transitions and connections among multiple communications media, e.g. Wi-Fi, Wi-Max, EVDO, satellite, etc. It also captures network performance to feed the Perform Data Validation function.
Message Error Rate Data	Message error statistics developed in accordance with the technical rules defined in the SV-10a and populated into the appropriate AAtS Data Validation data element.

Acronyms/Name	Description
Metadata	Metadata (metacontent) is defined as data providing information about one or more aspects of the data, such as: • Means of creation of the data • Purpose of the data • Time and date of creation • Creator or author of data • Location on a computer network where the data was created • Standards used
MOA	Memorandum of Agreement
Monitor / Report Network Performance	This function monitors the numbers of errors that occur in the data validation function and provides performance metric inputs to the AAtS Data Validation data sets.
Monitor Data Synchronization	This function monitors the data that is used to track data synchronization between the aircraft and the ground user.
Monitor Network Performance	This process monitors the data that is used to track data synchronization between the aircraft and the ground user and provides performance metric inputs to the AAtS Data Validation data sets.
NAI	Non-Airworthiness Items
NAS	National Airspace System
NAS ATM Data Service Provider	An Air Traffic Management (ATM) data service which provides data such as traffic flow, playbook, traffic management initiatives, terminal movement, and arrival data.
NAS Data	Data provided by a SWIM-enabled NAS Program that is accessible to AAtS.
NAS Data Service Provider	A SWIM-enabled NAS Program that makes data accessible to AAtS.
NAS Enterprise Security Gateway	The NAS Enterprise Security Gateway is a framework for supporting mandated boundary protection services between SWIM and external entities. It provides a standardized scheme for connecting and managing connections to external users. It also enables a layered security scheme to provide defense in depth and provide a buffer between SWIM and external entities.
NAS SOA Service Provider	NAS SOA Services include the messaging and management functions needed to support SWIM operations.
NEMS	NAS Enterprise Messaging Services
NESG	NAS Enterprise Security Gateway
Network Performance Data	The numbers of errors that occur in the data validation function and provide performance metric inputs to the AAtS Data Validation data sets.
NextGen	Next Generation Air Transportation System
NMN	NEMS messaging node
NSRR	NAS Service Registry/Repository
Onboard Client	The system level instantiation of all related AAtS systems on board the aircraft. This could include multiple functions.

Acronyms/Name	Description
Operational Flight Plan	The Operational Flight Plan is the official travel itinerary that includes specific information in regards to a scheduled flight (e.g. route of flight, point of departure, point of destination, estimated time en route etc.) that has been selected by the Flight Operator from Approved Flight Plans for a particular flight.
OSED	Operational Services and Environment Definition
PDC	Pre-Departure Clearance
PED	Portable Electronic Device
Perform Compression / Expansion of Data	This function compresses or expands data based on parameters included with the message.
Perform Data Filtering Service	This function uses preset filter parameters to determine which data to present to a user. For example, if the aircraft requests sensor data from an airport, it may be really interested in a filtered set or an aggregated value instead of individual feeds from a larger number of sensors.
Perform Data Validation	This function includes the algorithms and data structures to determine the availability, continuity, latency, valid time frame, integrity, reliability and timeliness of the data. It provides that information to the user to enable an assessment of the permitted usage of the data.
Perform Protocol Translation	This function transforms one protocol to another, e.g. Java Messaging Service to an XML document and vice versa.
Populate Priority and Security Data Fields	This function maintains the algorithms and data structures that support the user's ability to determine the availability, continuity, latency, valid time frame, integrity, reliability and timeliness of the data.
Process Aircraft Data to Aeronautical Service	This process manages the flow of data from the aircraft via AAtS to a NAS aeronautical data service provider.
Process Aircraft Data to ATM Service	This process manages the flow of data from the aircraft via AAtS to a NAS ATM data service provider.
Process Aircraft Data to Weather Service	This process manages the flow of data from the aircraft via AAtS to a NAS weather data service provider.
Process data	This process includes general management of the processing of data received from an outside entity.
Process NAS and AAtS Data Validation Data	This process in the aircraft manages the processing of NAS program and AAtS Data Validation data received from the DMS.
Process Synchronization Data	This process in the AOC/FOC manages the processing of synchronization data received from the DMS.
Provide Aeronautical Information	Aeronautical information includes information such as notices to airmen, flight restrictions, special use airspace, etc.
Provide Air Traffic Management Information	This activity delivers air traffic management information which includes, but is not limited to, flow information, TMI information, playbook information, etc.
Provide Aircraft Access to SWIM	This function includes the sub-functions that manage access to the DMS from aircraft and ground-based users and included those functions needed to connect with the Security Gateway and exchange data with NAS services.

Acronyms/Name	Description
Provide Data Management Service	The services included in this capability can be physically located in one place or distributed across the network. They include that set of services that are needed to manage connections between aircraft and the R&D Security Gateway. Additionally, it maintains a number of data sets needed to manage transactions with the Security Gateway, aircraft, and external users.
Provide External Access to Data Management Service	This function enables external entities, e.g. AOC, FOC, to connect to the Data Management Service and to manage configurations for functions such as business rules, data filters, and subscriptions.
Provide NAS Collaboration Data	This is data that is shared between the aircraft and traffic flow management regarding strategic changes to trajectory.
Provide NAS Data	Data provided by a SWIM-enabled NAS Program that is accessible to AAtS.
Provide NAS Enterprise Security Gateway Service	This service provides communication management services and maintains secure communications by enforcing service and message security policies, verifying identities and digital signatures and providing authorization-based access.
Provide Weather Information	The Provide Weather Information activity supplies weather information to users by ensuring the assets, people, procedures and policies that produce the information are in place. The activity begins with the receipt of user needs and market information to guide the planning for and acquisition of weather assets. Private weather information, time, and position are used to produce weather information while adhering to applicable policies, standards, and agreements.
Provide Wireless Data Link Service	This function provides the wireless connections between the ground and aircraft, including knowing where the aircraft is, knowing which data links are available, calculating the best route for data, and making the connections to achieve the target end-to-end latency and availability.
Publish Aeronautical Data	This function delivers aeronautical information which includes but is not limited to notices to airmen (NOTAMS), flight restrictions (TFRs), special use airspace (SUA), etc.
Publish ATM Data	This function delivers air traffic management data which includes, but is not limited to, flow information, TMI information, playbook information, etc.
Publish Data	This process publishes unspecified data needed by one entity from another that is delivered in machine-readable format.
Publish Weather Data	This function delivers data about the meteorological conditions in a specific area. May include observations and forecasts.
RAPT	Route Availability Procedures Tool
Request for Service, MOA, Other Docs	These documents are completed and executed by an Extranet End User and a NAS Program Sponsor as part of the process of establishing a network connection to SWIM.
SAA Information	Information about Special Authorization Airspace, e.g. temporary flight restrictions or military operating areas.
SAP	Service Access Point
SBS	Surveillance and Broadcast Services
Service Registration Data	Data needed to register a service in the registry / repository. Typically includes the metadata needed to connect to the service.

Acronyms/Name	Description
SLA	Service Level Agreement
SLMP	Service Life Cycle Management Process
SOA	Service-Oriented Architecture
Space Conditions	The state of the atmosphere in terms of temperature and wind and clouds and precipitation as detected from space.
STC	Supplemental Type Certificate
Subscription Configuration Data	Data that configures the business rules that drive subscriptions in a service-oriented environment.
Subscription Configuration Information	The configuration parameters used to establish and modify subscriptions and recurring data requests.
Subscription Request	A request for a subscription to data published by a service.
Subscription Rule	A business rule that drives the configuration and frequency of a subscription.
Surface Conditions	The state of the atmosphere at the surface in terms of temperature and wind and clouds and precipitation.
Surveillance Information	Surveillance Information is the collection of attributes associated with an object that may include position, identification, and/or intent.
SWIM	System-Wide Information Management (SWIM) is an information technology program that will operate in the background to provide seamless information to users who have a valid need for the data. (Reference Program Overview for SWIM-SUIT Public Launch, April 2007)
SWIM Core Services	SWIM Core Services include the messaging and management functions needed to support SWIM operations.
Synchronization Data	Data that either notifies an aircraft or AOC of data transmitted to the other or copies of the data, in accordance with business rules.
Synchronization Rule	A rule that governs how the AOC/FOC will be kept informed of the data that is sent to the aircraft via AAtS.
TC	Type Certificate
TCAS	Traffic Collision Avoidance System
Technical Rule	A rule for guiding a decision, e.g. whether the aircrew or the AOC is allowed to negotiate strategic decisions with Air Traffic Management. May be implemented in the decision-support software algorithm in a business system.
Test Report	A report of the connection, application, and interoperability tests required to connect to SWIM.
TFM	Traffic Flow Management
TMI	Traffic Management Initiative
TRACON	Terminal Radar Approach Control
Traffic Flow Management Information	Traffic Flow Management information includes, but is not limited to, traffic flow, playbook, traffic management initiatives, terminal movement, and arrival data.
TSG	Telecommunications Services Group

Acronyms/Name	Description
TSO	Technical Standard Order
Use Data	A generic business process that entails the use of data and information provided by any source.
User Application	An application that consumes data from or provides data to the DMS. It may be a user or an aircraft application.
Video Surveillance Information	This information is captured and provided by the aircraft either through installed equipment or through the use of handheld equipment, e.g. cell phone.
VPN	Virtual Private Network
Weather Data	Data about the meteorological conditions in a specific area. May include observations and forecasts.
Weather Data Service	A SWIM-enabled NAS Program that makes data accessible to AAtS.
Weather Forecasts	A Weather Forecast is a prediction or estimation based on special knowledge of the future state of the atmosphere with respect to temperature, precipitation, and wind. (Source: National Oceanic and Atmospheric Administration).
Weather Information	Data about the meteorological conditions in a specific area. May include observations and forecasts.
Weather Policies / Standards	Policies that govern the collection, management and delivery of weather information.
Weather Tool	The Weather Tool is an integrated combination of components (e.g., hardware, software, and/or networks) designed, tested, and maintained specifically to gather and transform Weather Information. The Weather Tool ICOM is used to represent the following component ICOMs: Weather Observation Tool, Weather Analysis Tool, and Weather Forecasting Tool.
Wireless Data Link Service Provider	The Wireless Data Link Service Provider provides the wireless connections between the ground and aircraft, including knowing where the aircraft is, knowing which data links are available, calculating the best route for data, and making the connections to achieve the target end-to-end latency and availability.
Wireless Data Link Services	The Wireless Data Link Service manages and provides the wireless connections between the ground and aircraft, including knowing where the aircraft is, knowing which data links are available, calculating the best route for data, and making the connections to achieve the target end-to-end latency and availability.
WSDD	Web Services Description Document
WSDL	Web Services Description Language
Wx Data Service	A source of information about weather including observations and forecasts.

APPENDIX C – OPERATIONAL USE CASE SCENARIOS

Use case scenarios explore the operational benefits AAtS may provide and were designed to illustrate the potential uses for AAtS. The primary actor in each of the four scenarios is the flight crew operating the aircraft. The aircraft, flight operation (commercial, private, GA), and events encountered during flight will alternate among the four scenarios to explore the AAtS concepts of use throughout all phases of flight.

General Assumptions

AAtS in the future is expected to provide the communications gateway for flight crews to receive data provided by SWIM supported information services.

AAtS will provide advisory/supplemental information from data classifications:

- Aeronautical information
- Traffic flow management information
- Weather information.

Each use case scenario will address a specific condition in the NAS and how AAtS will provide necessary information to the flight crew that will improve their situational awareness.

- All AAtS system architecture is fully developed and implemented
- Aircraft are fully equipped to access SWIM services
- PED is a general term used in this document to represent a display devise used to display AAtS information by a third-party vendor or a display developed by a third-party vendor to display AAtS information
- Commercial vendors will create applications for the display of AAtS data.

The use case scenarios will cover all phases of flight:

- Pre-flight/Flight Planning
- Pushback / Taxi
- Takeoff / Climb
- Domestic En Route Cruise
- Descent /Approach
- Landing/Taxi/Park

Roles and Responsibilities Assumptions

Managing the NAS, controlling air traffic and ensuring traffic moves safely and efficiently remain under the control of the decision makers such as the flight crew, AOC/FOC, and ATM. Key considerations are:

- The flight crew will have the ability to choose alternate preferred routes given access to near real-time NAS data and information. The flight crew can set parameters for data sets to extract data and information pertinent to their flight path.

- Trajectory negotiations will not be made over AAtS; the flight crew will still have to negotiate flight plan and route changes with the decision-making authority (AOC/FOC/Dispatch, if there is one available, and the appropriate ATM).
- Guidance will be in place to advise flight crew usage of AAtS.
- Appropriate policy will be initiated as to the use of SWIM data by vendors and users.

Guidance Assumptions

- Information provided by AAtS will be non-safety critical. Information provided will not directly affect the trajectory of the aircraft
- AAtS will not provide control clearances or instructions
- The flight crew will be able to subscribe to SWIM-provided services as well as configure the PED, to automatically retrieve information according to set parameters such as:
    - Airport information for the destination airport
    - Weather information along the planned route of flight
    - Flow information impacting the flight operations.

At the end of each scenario, a benefits statement will be written and it will address the phase of flight and the expected benefits of AAtS.

Use Case Scenario Constants

For the purposes of brevity and to maintain a consistent format for the presentation of the following use case scenarios, this section will define the constants that exist during flight operations and explain the different aspects as to the rules and regulations under which flights operate and are certificated.

Each use case scenario will transition through all phases of flight.

There are several different FAA certifications that flights carrying passengers are flown under. The first three use case scenarios in this document are flown under 14 CFR Part 121 Commercial Operations. The fourth use case scenario deals with a small corporate flight operation operating under 14 CFR Part 91. Under these different operating scenarios, the rules governing the flight crew and the company’s flight department differ, but all utilize the airspace the same way.

Flights conducted under 14 CFR Part 121 Commercial Operations, utilize an Airline Operation Center (AOC) or Flight Operation Center (FOC). Within this structure, flight dispatchers, which handle numerous flights each, produce different releases for every aircraft movement. It is the responsibility of the Pilot-in-Command (PIC) to ensure that each flight has the appropriate dispatch release and that the contents are accurate. The key items on the dispatch release per 14 CFR Part 121.187:

- ID number (tail number of the aircraft to be flown)
- Flight number
- Departure airport
- Destination airport and alternate, if required
- Type operation, (IFR/VFR)

- Filed route of flight and altitude
- Minimum fuel to conduct the flight
- All Deferred Maintenance Items (DMI), and
- Non-Airworthiness Items (NAI).

Other pertinent flight related items such as current, forecast and depicted weather, Notices to Airman (NOTAMs) and fuel burn in relation to route fixes are also incorporated within the dispatch release. The flight crew should reference all applicable flight manual bulletins. Load and balance data may be forwarded to the flight crew via Aircraft Communications and Reporting System (ACARS), ARINC or company VHF radio approximately 5-8 minutes after push back. The load and balance data, in addition to the dispatch release, is required for departure to assure the aircraft is loaded within operating limits and also provides the weights necessary to calculate the takeoff velocity speed (V speeds).

The first three use case scenarios are operating under 14 CFR Part 121 and will have a dispatch release briefed by the flight crew and discussed with the dispatcher if necessary, after one of the crew has received the current Automatic Terminal Information Service (ATIS) and received their clearance and route from Clearance Delivery controller. Once all necessary information has been collected, the flight crew performs a Clearance Brief prior to push back.

In use case scenario four, the flight is operating under 14 CFR Part 91. The aircraft operator contracts with a “for-fee” flight planning service. This service provides a flight planning function and weather briefing similar to an AOC. For the scenarios, the term Clearance Brief with cover all required pre-flight checks and briefings.

Once on board the aircraft, the flight crew configures the PED to retrieve automatic updates for relevant flight information, such as updates to the NAS operational plan for the flight’s primary and alternate airports and their surface conditions. The flight crew also configures the PED for convective weather, wind information and forecasted weather that may affect the planned route of flight and altitudes. The flight crew also checks for any TMIs in effect such as airborne holding, GDPs, or GSs. They also review information presented on the PED for current departure delays and the current operational plan for any potential system impacts en route, or possible reroutes.

Prior to each flight, the flight crew receives the dispatch release which has the required city pairs, route, weather, altitude, minimum fuel, aircraft ID, and deferred maintenance items (DMIs) as per 14 CFR Part 121.187. The ATCT Clearance Delivery controller is contacted approximately 30 minutes prior to push back by the flight crew to receive their clearance, check that it matches the dispatch release route and it is loaded into the Flight Management Function (FMF). The flight crew then conducts the Clearance Brief as the passengers are boarding the aircraft.

On the arrival segment of the flight, the Arrival Brief, conducted by the flight crew, includes reviewing the ATIS for current weather and wind information, airport configuration and special announcements pertaining to the airfield. The crew briefs the arrival procedure and the planned approach procedure, fuel status, terrain, Ground Proximity Warning System (GPWS), Traffic

Collision Avoidance System (TCAS) alerts, altitudes, speeds, crosswinds, runway exit plan after landing and emergency/go-around procedures.

AAtS Use Case Scenarios

This section demonstrates potential uses of AAtS from the flight crew perspective; the impact of providing greater access to information not currently available to the flight crew. The proposed concepts of use are illustrated in four scenarios:

1. A transcontinental flight under VMC conditions;
2. A domestic airline flight under IMC conditions, predictable adverse weather conditions;
3. A domestic airline flight under IMC conditions, unpredictable adverse convective weather and;
4. A domestic General Aviation (GA) flight under VMC changing to IMC conditions and operating on-demand (an unscheduled flight).

These use case scenarios are not intended to prescribe software, hardware solutions or interface design requirements, but rather highlight how AAtS can be used and under various meteorological conditions by a variety of flight operators (i.e. commercial and GA) to identify possible benefits of AAtS use and implementation. Additionally, these use case scenarios can also be used to identify areas for further analysis and research, such as:

- Human factors concerns
- Required bandwidth
- Timing of AAtS delivery of data/information

The actors in the use case scenarios are the human system users. Not all of the use case scenarios will involve the same set of actors. The actors are defined in the Table C-1.

Actors	Roles and Responsibilities
Flight crew; Captain and First Officer (FO)	Primary recipients and users of NAS information
AOC/FOC; Dispatcher, ATC Coordinator and AOC Manager	Authorize and coordinate changes to flight plans
Certified Professional Controller (CPC) from ATCT, TRACON and ARTCC	Control airspace operations, traffic flow management
Traffic Flow Managers	Evaluate the NAS environment. Manage traffic flows and airspace usage
ANSP	Data source serving aeronautical and weather information

Table C-1 – System and Human Component Roles and Responsibilities

Appendix C.1 – Operational Use Case Scenario 1

Transcontinental Flight (LAX to JFK – VMC)

Purpose

This use case scenario explores AAtS capabilities and services with no expected weather impacts or system interruptions. It will also explore contextual flight information exchanges and detail common situational awareness between the flight crew/flight deck and the NAS by providing the flight crew with descriptions of the overall traffic demand and/or activity in surrounding airspace.

Goal(s)

- Identify benefits derived from on-demand NAS information throughout the flight
- Demonstrate common situational awareness between the flight crew, AOC and ANSP

Scenario background description

A B767 commercial airliner scheduled for a transcontinental flight departing Los Angeles International Airport (LAX) at 1645Z for John F. Kennedy International Airport (JFK); 5 hours and 16 minutes flight. The filed route is LAX VNY9 DAG J100 SAKES J100 EKR CYS J148 ONL Q122 FOD KG75M DAFLU J70 LVZ LENDY5 JFK with a filed cruise altitude of FL310. The flight plan route will be conducted through the following FAA facilities: Los Angles tower (LAX)/ Southern California TRACON (SCT)/Salt Lake (ZLC) Denver (ZDV)/ Minneapolis (ZMP)/ Chicago (ZAU)/ Cleveland (ZOB), New York (ZNY)/ NY TRACON (N90) and Kennedy tower (JFK). LAX terminal airspace, SCT terminal airspace is currently operating under Visual Meteorological Conditions (VMC), and no weather impacts to the filed route are expected. N90 is also operating under VMC, and the surrounding airspace is expected to remain in VMC.

The arrival runway at JFK is currently undergoing repair; however, it is expected to be completed before the international (arrival or departure) traffic becomes a factor with no impact on normal demand. Route and MIT restrictions are in effect for all flights into ZNY during the afternoon peak traffic demand. The normal afternoon traffic volume at JFK is currently at capacity.

Flight Planning

1600Z - Flight crew carries out the Clearance Brief.

The flight crew found no impacts (i.e., weather, flight and flow, or aeronautical) to their flight.

Push Back / Taxi

1645Z - the aircraft pushes back from the gate, starts engines, and proceeds as directed by ground control (GC) to taxi to their assigned departure runway.

The FO requests pushback clearance from ramp control and taxi clearance from the GC, and the captain taxis to the departure runway. Holding short of the departure runway, the FO contacts the tower for takeoff clearance.

Takeoff / Climb

1705Z - the flight crew receives clearance from the tower and commences takeoff roll.

The tower clears the flight for takeoff and the flight crew commences take off roll, takes-off and commences initial climb. The tower instructs the flight crew to contact SCT Departure, and the flight crew continues climb out and they reaches cruising altitude 15 minutes later. Once in cruise flight and leaving SCT the flight crew is instructed to contact the ZLA ARTCC controller.

Domestic En Route Cruise

1810Z - Moderate turbulence has been reported at FL310 along the route.

The flight crew gets an update through a portable EFB notifying them that there are PIREPs of moderate turbulence along the current flight route at their altitude. The flight crew enters a request into the PED for turbulence information at altitudes above and below their current altitude. SWIM turbulence information indicates less turbulence at FL330, the flight crew requests FL330 from ZDV. ZDV then clears the flight for the requested altitude; avoiding the turbulence.

2000Z - Arrival Runway reopens

The flight crew receives notification on the PED that the NOTAM for JFK runway closure has been canceled.

2025Z - Dispatcher confirms runway 31L has reopened at JFK.

2045Z - 30 minutes into ZOB airspace the flight crew is notified through the PED high-speed taxiway Mike Delta has been closed due to a disabled aircraft resulting in up to 15 minute arrival delays into JFK

At this time, it is unknown when the high-speed taxiway will reopen. This taxiway closure may impact the Runway 31L arrival rate creating airborne delays. The flight crew starts planning for alternative runway and possible airborne holding.

2055Z - The flight crew receives notification through their PED of an ATCSCC advisory that high-speed taxiway Mike Delta is closed due to a disabled aircraft. Runway 31L arrival rate is reduced from 32 to 20 due to anticipation of increased spacing on final - expect airborne holding of 15 to 30 minutes.

2120Z - The flight crew receives holding instructions with expect further clearance (EFC) time of 2135Z.

The flight enters holding and commences their Descent/Arrival check list items.

2130Z - The flight is cleared out of holding and the flight crew is instructed to contact N90.

Descent /Approach

2135Z - The flight crew initiates the descent from cruse altitude into JFK.

Landing/Taxi/Park

2155Z - The flight crew is instructed to contact the tower for landing clearance to Runway 31L

2210Z - The flight lands Runway 31L, nine minutes late, and taxis to the gate.

Table C1-1 Operational Use Case Scenario 1 provides a side-by-side comparison of operations today given this scenario compared to AAtS operations to highlight proposed benefits.

Without AAtS	With AAtS
1600Z Flight crew performs the Clearance Brief	**1600Z** Flight crew performs the Clearance Brief The flight crew configures the PED to retrieve relevant information for any updates for LAX/JFK or airspace along there route of flight, to deliver weather information/convective forecast updates for the en route airspace along the filed route of flight. This information is received and displayed to the flight crew, which shows favorable weather and winds along the filed route. The flight crew reviews the PED for current departure delays out of LAX and the current operational plan for any potential system impacts en route, delays, and reroutes. The operational plan provides current wind routes for JFK arrival traffic; the flight crew compares these wind routes to the filed route to

Without AAtS	With AAtS
	ensure that the planned route conforms to the wind routes. The flight crew checks for TMIs both current and planned for JFK. The flight crew checks the PED for upper winds information they have received.
1645Z The flight crew taxis the aircraft for departure after receiving clearance from ATCT. Once at the end of the runway, the flight crew contacts the tower for takeoff clearance.	**1645Z** The flight crew taxis the aircraft for departure after receiving clearance from ATCT. Once at the end of the runway, the flight crew contacts the tower for takeoff clearance.
1655Z The flight is cleared for takeoff. The aircraft departures and then commences initial climb. After takeoff the tower instructs the flight crew to contact departure control. The flight climbs out and departs LAX terminal airspace without incident. The flight reaches cruising altitude 15 minutes later.	**1655Z** The flight is cleared for takeoff. The aircraft departures and then commences initial climb. After takeoff the tower instructs the flight crew to contact departure control. The flight climbs out and departs LAX terminal airspace without incident. The flight reaches cruising altitude 15 minutes later.
1835Z The flight encounters moderate turbulence at FL310. Flight crew requests any PIREP information ZDV has for turbulence in the area and if they know of any better rides. ZDV asks ride reports from flights in the sector. Includes flights above and below the current altitude. **1852Z** ZDV advises the flight that FL330 has been reported as smooth. The flight crew request FL330. (Not having access to AAtS data required 17 minutes and a number of ATC transmissions to find a better ride.)	**1810Z** The PED notifies the flight crew of recent PIREPS of moderate turbulence along their route at their current altitude entering ZDV. The flight crew enters a request into the PED for turbulence information above and below their current altitude. From this, the flight crew becomes aware of less turbulence at FL330. Given this information, the flight crew request FL330 from ZDV, ZDV assigns the flight FL330
2035Z At 2035Z, the flight crew is advised through ACARS that the NOTAM for JFK has been cancelled	**2000Z** The PEDs indicate the receipt of a recent change to a previously published NOTAM for JFK. The flight crew receives notification the NOTAM for JFK has been cancelled and the runway has reopened. The flight crew checks D-ATIS information and plan for descent and arrival into JFK

Without AAtS	With AAtS
The flight crew reviews the ATIS for current weather and runways in use, and brief on their altitude speed, crosswinds, and exits they should expect to take after landing	The flight crew also review the D-ATIS for current weather and runways in use, and brief on their altitude speed, crosswinds, and exits they should expect to take after landing
2045Z The flight crew is unaware of closure to high-speed taxiway Mike Delta has been closed due to a disabled aircraft resulting in up to 15 minute arrival delays into JFK **2120Z** +15 minute arrival delays into JFK, ZNY issues airborne holding with EFC of 2135Z (The flight crew was unaware of the taxiway closure and possible delays and contacts dispatcher to find out the reason for delay and how long it may last). The flight enters holding and the flight crew performs their Descent/Arrival checklist. **2130Z** The flight is cleared out of holding to JFK. **2135Z** The flight crew initiates the descent from cruse altitude into JFK and is instructed contact N90. **2155Z** The flight crew is instructed to contact the tower for landing clearance to Runway 31L **2210Z** The flight lands Runway 31L, nine minutes late, and taxis to the gate.	**2045Z** The flight crew is notified through the PED that high-speed taxiway Mike Delta has been closed due to a disabled aircraft resulting in up to 15 minute arrival delays into JFK **2055Z** The flight crew receives notification through their PED of an ATCSCC advisory that high-speed taxiway Mike Delta is closed due to a disabled aircraft. Runway 31L arrival rate is reduced from 32 to 20 due to anticipation of increased spacing on final - expect airborne holding of 15 to 30 minutes. **2120Z** +15 minute arrival delays into JFK, ZNY issues airborne holding with EFC of 2135Z (From the information provided by the PED the flight crew was expecting the delay). The flight enters holding and the flight crew performs their Descent/Arrival checklist. **2130Z** The flight is cleared out of holding to JFK. **2135Z** The flight crew initiates the descent from cruse altitude into JFK and is instructed contact N90. **2155Z** The flight crew is instructed to contact the tower for landing clearance to Runway 31L **2210Z** The flight lands Runway 31L, nine minutes late, and taxis to the gate.

Table C1-1 – Operational Use Case Scenario 1

<u>Demonstrated impacts from AAtS implementation</u>

- ***Reduces impact on the NAS through increased situational awareness.***
  - Updated winds aloft and turbulence information supplied by AAtS allowed the flight crew to anticipate turbulence and request another altitude.
    - Reduced frequency congestion by using an alternate source of information other than a radio transmission.
  - Additional sources of weather information facilitated more accurate assessment of weather severity without requesting more information over the radio.
    - Reduced frequency congestion.
    - Shortened flight time and fuel usage by avoiding a needless deviation from the filed route.
  - Using AAtS to access runway in use and taxiway status at JFK reduces the need to gather information over the radio, reducing frequency congestion and increasing cockpit safety by reducing last minute planning and adjustments.
  - These benefits all result from increased situational awareness.
- ***AAtS implementation reduces system delays, allows flight crews to anticipate problems and provides sufficient time to design workarounds.***
  - Advanced information on turbulence at the flight's requested altitude allowed the crew to find an alternate altitude and avoid the reported turbulence.
    - The aircraft avoided the stress on the airframe and eliminated a dangerous situation for the flight attendants and an unpleasant/ dangerous experience for the passengers.
  - Additional weather information provided beyond what is currently available to flight crews now provides them supplemental weather outside the range of their onboard radar system and available pilot reports.
    - The flight crew was able to make a decision using more information and sufficiently ahead of reaching the weather to make a reasoned judgment.
    - Avoiding deviations around weather reduced system complexity and possible system delays resulting from increased complexity.
  - NOTAMS automatically routed to the aircraft PED notified the crew of runway and taxiway status and of delays so that they could judge the severity of congestion at their destination before their clearance to hold was delivered.
- ***Increases information exchange between flight crews and air traffic control, providing real-time information to flight crews; alleviating unnecessary radio transmissions***

- Information provided on weather, NOTAMS, D-ATIS and turbulence reports facilitated timely decision-making and obviated the need to solicit information on the radio.
    - Positive effect for the flight crew and the quality of the flight for passengers through more complete information than is presently available.
- Timely delivery of additional information allowed sufficient time for the flight crew to assess conditions and make more accurate and satisfactory choices.

Appendix C.2 – Operational Use Case Scenario 2

Domestic Flight (ORD to IAD – IMC)

Purpose

This use case scenario explores the use of AAtS capabilities and services under adverse but forecasted weather conditions. It will also explore flight information exchanges within a given context and detail common situational awareness between the flight crew/flight deck and the NAS by providing the flight crew with descriptions of the overall traffic demand and/or activity in surrounding airspace.

Goal(s)

- To demonstrate common situational awareness between the flight crew, AOC and ANSP
- Provide greater awareness of rapidly changing meteorological conditions, and
- The weather's impact on airport operations.

Scenario background description

A B767 commercial airliner scheduled flight departing Chicago O'Hare International Airport (ORD) at 1545Z for Washington Dulles International Airport (IAD); a 1 hour 35 minute flight. The filed route is KORD EARND ELANR EMMLY ERECO IIU J8 HVQ SHNON2 KIAD with a filed cruise altitude of FL310. The flight plan route will be conducted through the following FAA facilities; Chicago Tower (ORD)/Chicago TRACON (C90)/Chicago (ZAU)/Indianapolis (ZID)/Washington (ZDC) and Potomac TRACON (PCT), and Washington Dulles Tower (IAD). Both TRACON facilities, C90 and PCT, are operating under Instrument Meteorological Conditions (IMC). Both airports are impacted by snow and snow removal is expected to be a factor at both airports. Runway closures and GDP/GS are possible. Aircraft de-icing is underway at ORD and the airport arrival rate (AAR) and airport departure rate (ADR) are reduced. This use case scenario's goal is to show the benefit of AAtS on flight operations, specifically the benefits during a snow event. Normally these irregular operations are known well in advance of the event and are well planned by the ANSP, the Airport Authorities and the users and the ability of their flight operations department to adjust their schedule. The level of impact to the airport and snow removal considerations is usually an unknown variable.

Flight Planning

1500Z – The flight crew carries out the Clearance briefing

After the flight crew carries out the Clearance Brief, the flight crew configures their PED (see scenario constants). The information displayed to the flight crew shows snow impacting both airports throughout the day. The PED also displays current ORD departure delays and the current operational plan for any potential system impacts en route, delays, or possible reroutes. The operational plan expects snow to impact arrivals for IAD, due to snow removal and runway closures: expecting a GDP for arrivals 1700Z and later.

The AOC advises the flight crew of a GDP for IAD and the flights EDCT is 1700Z. The flight crew plans to push from the gate on time and taxi out to start aircraft deicing to meet the 1700Z EDCT.

Push Back / Taxi

1545Z - The FO requests pushback clearance from ramp control. The flight crew keeps the APU running and deicing commences. To increase the holdover time, especially at ORD, the Captain elects to start deicing with Type I glycol mix and supplement with Type IV.

1645Z – With deicing completed and holdover times good until 1715Z, the flight crew receives runway assignment and taxi instructions. The flight crew starts the engines, taxis as instructed, contacts the tower, and waits for takeoff clearance.

Takeoff / Climb

1700Z - Meeting the assigned EDCT, the flight is instructed to line up and wait.

The flight crew receives take off clearance from the tower and starts its takeoff roll, takes off and commences initial climb. They reach cruising altitude 15 minutes later.

En Route Cruise

1730Z - Moderate turbulence has been reported at the current altitude along the route.

The flight crew is notified by the PED of PIREPs for light to moderate turbulence along the current route of flight at their altitude. The flight crew checks for current turbulence PIREPs at alternate altitudes for better ride reports. PIREPs indicate that turbulence has been reported at most altitudes, but only a small area around Louisville, KY VOR (IIU). Based on this information the flight crew does not request an altitude change, but advises the flight attendants and passenger cabin of possible turbulence.

1805Z - The flight crew is notified by PED that runway 1L at IAD will close at 1830Z for one hour, for snow removal and that airborne holding greater than 15 minutes is possible.

1850Z - The flight crew is issued airborne holding instructions from ZDC at FINKS intersection, with an EFC of 1915Z.

The flight enters holding and commences their Descent/Arrival check list items. Additional to the normal checklist items, the flight crew investigates alternative airport information due to lengthy holding and minimum fuel requirements in case a diversion is required.

1915Z - The flight is cleared out of holding and continues on course to IAD

1920Z - The PED notifies the flight crew that runway 1L at IAD will open at 1925Z.

1925Z - Via the PED, the flight crew receives notification that the NOTAM for the IAD runway closure has been canceled and runway 1L has now reopened.

Descent / Arrival

1930Z - The flight crew contacts PCT and told to expect radar vectors to ILS runway 1L.

Approach / Landing

1945Z - The flight is cleared to land runway 1L.

1955Z - the aircraft lands Runway 1L at IAD and taxis to the gate.

Table C2-1 Operational Use Case Scenario 2 provides a side-by-side comparison of operations given this scenario compared to AAtS operations to highlight the proposed capability benefits.

Without AAtS	With AAtS
1500Z Flight crew performs the Clearance Brief	**1500Z** Flight crew performs the Clearance Brief Using the PED the flight crew accesses the ORD airport information for updates on deicing times, taxi times and current departure delays. The flight crew also configures the PED to trigger the retrieval of relevant information for any updates for ORD/IAD or airspace along their route of flight **1515Z** The flight crew configures the PED to deliver 1- hour weather information/turbulence forecast updates for the en route airspace along the filed route of flight Information is received and displayed to the flight crew, which shows favorable weather and wind along the filed route The flight crew enters a request on the PED to retrieve and display information on ORD/IAD, including detailed aeronautical information. The forecast

Without AAtS	With AAtS
	weather events displayed on the PED show significant snow possible for ORD and IAD The flight crew reviews the PED for current departure delays out of ORD and the current operational plan for any potential system impacts en route, delays, and reroutes. The operational plan for IAD has snow removal with runway closures, probable GDP. The crew also checks for TMIs in effect at IAD. The flight crew checks the PED for upper winds information they have received. **1505Z** The flight crew is notified by the PED of GDP for IAD, the flight crew checks their EDCT of 1700Z and reads ATCSCC advisory for GDP
1525Z The flight crew is contacted by AOC and notified of the IAD GDP advertised and their EDCT is 1700Z **1530Z** The crew contacts AOC to find out what the reason for the GDP is. **1535Z** The Dispatcher contacts the crew and reads ATCSCC advisory to them	
1545Z The FO requests pushback clearance from ramp control. With the APU running, commences deicing. To increase the holdover time, especially at ORD, the Captain elects to start with Type I glycol mix and supplement with Type IV.	**1545Z** The FO requests pushback clearance from ramp control. With the APU running, commences deicing. To increase the holdover time, especially at ORD, the Captain elects to start with Type I glycol mix and supplement with Type IV. **1550Z** The flight crew, using the PED, checks automated winter forecast display for snow bands moving through the Washington DC area. The two hour forecast displays light to moderate snow at times
1555Z ORD ATIS - current weather conductions, 600 overcast, visibility two miles, light snow, ORD airport and runway configuration, ORD is conducting snow removal and de-icing. Departing 32 L/R and braking action reported as fair, patchy	**1555Z** ORD ATIS - current weather conductions, 600 overcast, visibility two miles, light snow, ORD airport and runway configuration, ORD is conducting snow removal and de-icing. Departing 32 L/R and braking action reported as fair, patchy snow and ice and that runway 28 closed for snow removal.

Without AAtS	With AAtS
snow and ice and that runway 28 closed for snow removal.	
1645Z With deicing complete, the flight crew request and receives taxi clearance. They taxi as instructed to the assigned runway, contact the tower for takeoff.	**1610Z** Using the PED, flight crew checks current operational plan for IAD. It's reported that there are possible system impacts en route; expecting possible airborne holding due to snow removal and volume. **1645Z** With deicing complete, the flight crew request and receives taxi clearance. They taxi as instructed to the assigned runway, contact the tower for takeoff.
1700Z Meeting the assigned EDCT, the flight is instructed to position and wait The flight crew receives take off clearance from the tower and they starts their takeoff roll, takes off and begin their initial climb. They reach cruising altitude 15 minutes later.	**1700Z** Meeting the assigned EDCT, the flight is instructed to position and wait The flight crew receives take off clearance from the tower and they starts their takeoff roll, takes off and begin their initial climb. They reach cruising altitude 15 minutes later.
1800Z The flight encounters turbulence in the area of IIU VOR. The Cabin Crew advises the flight deck that one of the cabin staff hurt their ankle. The captain suspends cabin service, turns on the seat belt sign, and returns everyone to their seat; including	**1730Z** Moderate turbulence has been reported at the flight's current altitude along the route. The flight crew receives notification on the PED of PIREPs for light to moderate turbulence along the current route of flight at their altitude. The flight crew checks for current turbulence PIREPs at alternate altitudes for better ride reports. Current PIREPs indicate that turbulence has been reported at most altitudes, but only a small area around Louisville, KY VOR (IIU). Based on this information the flight crew does not request an altitude change but advises the flight attendants and passengers of possible turbulence. **1800Z** Flight encounters turbulence in the area of IIU. **1805Z** The PED notifies the flight crew of ZDC/PCT airborne holding for IAD +15 minutes now expected to reach +20. The Airport Authority has posted that Runway 1L to close at 1900Z to 2000Z for snow removal.

Without AAtS	With AAtS
the flight attendants. Flight crew contacts ZID requesting PIREPS on turbulence; controller contacts other flights in the area for feedback. The controller asks three flights in the area, and determines that turbulence is at most altitudes.	
1840Z The flight crew has not encountered any more turbulence or heard any additional reports on the frequency so the captain advises the cabin crew and restarts cabin service.	**1840Z** The anticipated area of turbulence materialized, and the flight crew had chosen to ride it out for approximately 20 minutes. The flight crew checked real-time updates and concluded, after the chop subsided, to return cabin service. The Captain turned off the fasten seat belt sign.
1850Z Upon contacting ZDC, the controller issues airborne holding at FINKS intersection with an EFC of 1915Z to the flight crew. The flight crew questions the controller about the holding, the cause of it and whether he foresees the EFC being extended. The controller advises the flight crew of the runway closure and that he is not sure how long it will last.	**1850Z** Upon contacting ZDC, the controller issues airborne holding at FINKS intersection with an EFC of 1915Z to the flight crew. The flight crew enters the holding and commences their Descent/Arrival checklist. Additional to the normal checklist, the flight crew is investigates alternative airport information due to lengthy holding and minimum fuel requirements in case a diversion is required.
1855Z The flight crew contacts the AOC on the holding, asks if they know anything more and what they should expect. The AOC contacts the ATCSCC for information on the holding and the ATCSCC contacts ZDC for an update.	
1900Z The flight enters holding and commences their Descent/Arrival checklist items. In addition to the normal checklist items, the flight crew investigates alternative airport information due to lengthy holding and minimum fuel requirements in case a diversion is required.	

Without AAtS	With AAtS
1910Z The fight crew is advised by AOC that holding is expected to be in the 15 minute range **1915Z** The flight is cleared out of holding and the flight crew continues the route to IAD	**1915Z** The flight is cleared out of holding and the flight crew continues the route to IAD **1920Z** The PED notifies the flight crew that runway 1L will open at 1925Z. **1925Z** Via the PED, the flight crew receives notification that the NOTAM for the IAD runway closure has been canceled and Runway 1L has now reopened.
1930Z The flight crew contacts PCT and receives the approach procedure and runway to expect.	**1930Z** The flight crew contacts PCT and receives the approach procedure and runway to expect. The flight crew uses the PED to check winter storm forecast to see snow volume and how it may impact visibility at the airport. Additional real-time information that is gathered from the PED including current RVR and braking reports. A recent PIREP from a B757 states braking action for runway 1L is good.
1955Z The aircraft lands Runway 1L at IAD and taxis to the gate.	**1955Z** The aircraft lands Runway 1L at IAD and taxis to the gate.

Table C2-1 – Operational Use Case Scenario 2

Demonstrated impacts from AAtS implementation

- ***Reduce impact on current system through increased situational awareness.***
  - Flight crew is able to get a clear picture of the situation along their route of flight before takeoff.
    - Crew can discuss possible alternatives to conditions along route.
    - The crew can consult company about suggested strategies.
    - The crew can anticipate air traffic control clearances in response to flight conditions.
  - Long before clearance into holding near destination airport the crew anticipates delays.
    - If necessary they can consider changes in cruise speed control or review published holding fixes.
    - Passengers can be advised of possible arrival delays.
    - They can review PED for a clearer picture of airport conditions.

- ***Reduce system delays, anticipate problems, and provide sufficient time to design workarounds.***
    - Through advance information provided by AAtS the flight crew can anticipate air traffic control programs.
        - Advanced distribution of the destination ground delay program allows the crew to research at what point in route the aircraft will enter a holding pattern.
            - Early flight crew awareness of destination events facilitates an orderly discussion of conditions to expect and investigation of alternatives if necessary
                - Extra time translates into a more complete knowledge of alternatives and a crew discussion of possible alternatives.
    - System delays are possibly reduced through an alternative of information to solicitation on frequency and less time required to explain the reason for delays on frequency.
        - Providing additional channels of information can reduce frequency congestion and so reduce air traffic complexity.
        - Orderly assessment of flight conditions by the crew facilitated by timely distribution of information raises the quality of crew decisions and shifts some of the burden of information delivery from air traffic control to AAtS.
- ***Increase information exchange between flight crews and air traffic control, provide real-time information to flight crews, eventually reduce frequency congestion***
    - AAtS distributed vital information in this scenario directly to the crew that facilitated timely and orderly decision-making.
        - Access to this information reduced the need to solicit it from air traffic control.
        - When the flight crew made a decision, air traffic control would require a shorter explanation for the decision because they shared the same situational awareness.
        - The threat of frequency congestion is reduced through access to this information by a different communication channel.
    - Air traffic control can target the most essential information to the flight crew when the requirement to deliver less essential information by radio is reduced.

Appendix C.3 – Operational Use Case Scenario 3

Domestic Flight (SFO to ORD – Convective weather event - IMC)

Purpose

This use case scenario explores AAtS capabilities and services under adverse weather conditions but with uncertain impacts. It will also explore contextual flight information exchanges and detail common situational awareness between the flight crew/flight deck and the NAS by providing the flight crew with descriptions of the overall traffic demand and/or activity in surrounding airspace.

Goal(s)

- Identify benefits derived from on-demand NAS information throughout the flight
- Demonstrate common situational awareness between the flight crew, AOC and ANSP
- Provide greater awareness of rapidly changing meteorological conditions, during a convective weather event.
- The impact of reduced system capacity, and airborne reroutes

Scenario background description

A B737 commercial airliner scheduled for a domestic flight departing San Francisco International Airport (SFO) at 1230Z for Chicago O'Hare International Airport (ORD); a 3 hour and 45 minute flight. The filed route is SFO BCE J100 EKR BFF J94 DBQ JVL BULLZ1 ORD with a filed cruise altitude of FL310. The flight plan route will be conducted through the following FAA facilities: SFO tower/ Northern CA TRACON (NCT)/Oakland (ZOA)/Salt Lake (ZLC)/Denver (ZDV)/Minneapolis (ZMP)/Chicago (ZAU)/Chicago TRACON (C90) and Chicago tower (ORD). SFO terminal airspace is currently operating under IMC. SFO ground delay program for SFO arrival traffic is in effect but not impacting departure traffic. The current forecast predicts an area of convection along the boundary between ZAU / Kansas City (ZKC)/ZMP impacting ORD arrivals over the Janesville (JVL) and Bradford (BDF) arrival routes during the west arrival bank. ORD is not expecting the convection to reach the airport or impact the arrival rates at the airport. West departure routes will be impacted but west departure volume is light during this period and should not impact operations. A developing line of thunderstorms have been detected west of ORD, however, the current forecast cannot provide with high confidence, the time these thunderstorms will impact ORD operations. The current operational plan calls for ZMP/ZKC to monitor the weather and its impact. If needed ZMP or ZKC with the ATCSCC will develop TMIs to address the impact.

Flight Planning

1130Z - The flight crew carries out the Clearance briefing

The flight crew configures the PED to automatically retrieve any updated relevant flight information for departure, en route and destination.

The flight crew reviews flow information for current departure delays out of SFO and the current operational plan for any potential system impacts en route, delays, and reroutes. The operational plan defines possible reroutes for ORD arrivals at 1500Z and later. The flight crew configures the PED to indicate updates to the operational plans for ORD/Chicago (C90) that may occur.

Push Back / Taxi (Ground Movement)

1210Z - The FO request pushes back from the gate to taxi to their assigned departure runway.

The flight crew receives a more current ATIS (SFO is still IMC due to fog but this is not impacting departure operations) before requesting pushback and taxi clearance.

At 1210Z, the FO requests and receives a pushback from ramp control and taxi clearance from SFO ground control, taxis to the departure runway, and then contacts the tower (ATCT) for takeoff clearance. The flight departs on time.

Takeoff / Climb

1230Z - The aircraft takes off.

At 1230Z, the flight crew receives clearance from the tower and they commence their takeoff roll, takeoff and climb out without incident.

The tower instructs the flight crew to contact Departure (NCT), and the flight crew continues climb out. The flight crew gives a PIREP to departure (NCT), “top of the fog layer is 3000ft clear above.” Once in cruise flight and leaving NCT airspace, the flight crew is instructed to contact the ZOA ARTCC. The aircraft reaches cruising altitude 15 minutes later.

En Route Cruise

1315Z - Moderate turbulence reported in ZDV along most of the flight route.

At 1245Z, the aircraft has reached cruising altitude. The flight crew receives a notification on the PED of numerous reports indicating moderate clear air turbulence (CAT) in ZDV along the route of flight. The PED notifies the flight deck of PIREPs of moderate turbulence along the current flight route at their altitude. The flight crew enters a request into the PED for turbulence information at altitudes above and below their current altitude. The flight crew, through investigation of current SWIM turbulence information using their PED, they become aware of less turbulence at FL350. The flight crew requests FL350 from ZDV. ZDV then clears the flight for the requested altitude; avoiding the turbulence.

1425Z - Convective weather forecasted causing potential for reroutes for ORD west arrivals, playbook route may go into effect

The flight crew receives notification on the PED indicating a new operational plan for ORD due to uncertainty of when convection will start. ZKC and/or ZMP will be the trigger for reroutes if convection impacts arrival routes. The playbook route will be ORD JVL/BDF 2.

1455Z - Playbook route ORD JVL/BDF 2 has been executed.

The flight crew receives notification through their PED of an ATCSCC advisory that the JVL/BDF 2 playbook has been issued.

The flight crew opens the Playbook data information via SWIM link and reviews the route. After this review, they contact the dispatcher to ensure that they are able to accept the route ONL J114 GEP J106 GRB TVC WYNDE4. The dispatcher advises the crew they have sufficient fuel for the reroute. The crew programs the FMF with the route and saves it until it is issued.

The flight crew then configures the PED to retrieve the convective weather forecast for ZMP/ZKC. This forecast is displayed and shows convective weather developing in the area of ONL extending south of BDF.

1515Z - the flight crew receives a reroute.

ZDV clears the flight via two-way radio to give the direct route ONL FSD J114 GEP J106 GRB TVC WYNDE4. The flight crew configures the PED to deliver weather updates and turbulence information for the new route. The flight crew reviews the automated convective forecast on their PED, which shows the convective weather is forecasted to remain clear of the new route developing well south of the route.

1605Z - No convective weather but turbulence exists along the new route.

The flight crew receives notification on the PED of turbulence along the new route. Upon review, it shows that for the remainder of the flight the aircraft will be experiencing turbulence.

Before encountering turbulence, the flight crew instructs the cabin crew to cease cabin service and for everyone to remain seated for the remainder of flight.

Descent/Arrival

1615Z - the flight crew receives arrival airport information.

The flight crew checks PED for current information on ORD operations.

- Weather data
  - TAF and METAR for ORD, current weather VFR with no impact on the airport. TAF forecast good VFR conditions with the convection not impacting the airport until late evening.
  - D-ATIS for current airport weather for ORD arrivals includes approach in use, visual to 27R|27L|28.

    NOTE: *flight is still outside range to receive broadcast AITS.*

  - Flight crew reviews weather information to see if the convection forecast has changed.
- Flow Management
  - Flight crew reviews all the current reroutes for ORD to get an understanding of the total impact, (this will enable the flight crew to understand that some of the reroutes are to handle sector volume problems)

Currently, there are arrival delays for ORD and ZAU expects arrival delays the 30-minute range.

AAtS ORD arrival notifies the flight crew that ZAU expects arrival delays to be +30 minutes. The flight crew and AOC revise the arrival time from the reroute and possible holding. The flight is now expected to be at the gate, the information is communicated to the passengers.

1600Z - the flight deck receives current traffic flow, weather, and aeronautical information for ORD.

The flight crew performs their Descent/Arrival checklist.

The flight crew initiates the descent from cruse altitude into ORD.

Final Approach / Landing

1630Z - the aircraft lands at ORD and taxis to the open gate.

Table C3-1 Operational Use Case Scenario 3 provides a side-by-side comparison of operations today given this scenario compared to AAtS operations to highlight proposed benefits.

Without AAtS	With AAtS
1130Z Flight crew carries out the Clearance Brief The flight crew’s weather forecast information is limited to hard copy forecast from the dispatcher based on data more than 2 hours old.	**1130Z** Flight crew carries out the Clearance Brief The flight crew’s weather forecast information is limited to hard copy forecast from the dispatcher based on data more than 2 hours old. The flight crew configures the PED to trigger the retrieval of relevant information for any updates for SFO/ORD or airspace along the route of flight. The flight crew configures the PED to deliver weather information/convective forecast updates for the en route airspace along the filed route of flight. The PED displays convective weather possibly impacting ZKC/ZMP arrival routes into ORD. The flight crew enters a request on the PED to retrieve and display information on ORD, including detailed aeronautical information such as approaches. The flight crew reviews the PED for current departure delays out of SFO and the current operational plan for any potential system impacts. The operational plan has probable reroutes for ORD arrival traffic over BDF and JVL 1630Z and later. The flight crew configures the PED to indicate updates to the operational plans for ORD/C90 and ZAU.
1200Z The FO requests and receives a pushback from ramp control and taxi clearance from SFO ground control, taxis to the departure runway.	**1200Z** The FO requests and receives a pushback from ramp control and taxi clearance from SFO ground control, taxis to the departure runway.
1230Z Aircraft departs SFO and climbs out, clears tops at 3000 feet. FO passes PIREP to ATC on tops.	**1230Z** Aircraft departs SFO and climbs out, clears tops at 3000 feet. FO enters PIREP in PED on the tops during climb out.
1300Z Entering ZDV the Flight crew hears questions on turbulence between the ZDV controller and other aircraft. The flight crew asks for a report on the turbulence and is informed that it is at most altitudes. The flight crew advises	**1245Z** Flight crew is notified by the PED of reported turbulence in ZDV airspace. Flight crew checks the reported turbulence and finds turbulence is reported is confined to an area 150 miles ahead at their altitude and below for 100 miles. Reports indicate only light turbulence at FL350 and favorable tail wind that can reduce time en route by 7 minutes reducing fuel cost. Flight crew request FL350 from ZDV and is cleared to FL350.

Without AAtS	With AAtS
the cabin of possible turbulence and has the cabin crew stop all services. As the flight crew waits for the controller to get reports in the area, it ties up the frequency and takes time. After 10 minutes ZDV advises the flight crew FL350 reports only light turbulence and ask if they would like higher. The flight crew confirms the request and ZDV clears the flight to FL350. **1315Z** The cabin crew reports to the captain that one passenger and one of the cabin crew were hurt slightly from the turbulence.	
	1425Z The flight crew receives notification on the PED indicating a new OPS Plan for ORD due to uncertainty of when convection will start. ZKC and/or ZMP will be the trigger for reroutes if convection impacts arrival routes. The playbook route will be ORD JVL/BDF 2. **1430Z** The flight crew checks the convective forecast for weather development in ZKC/ZMP on the PED. Based on the operational plan the flight crew is looking for the weather development and possible reroute. The display on the PED is showing small areas starting to develop that may impact the routes.
1445Z The flight crew is checking their on-board weather radar but with the limited range does not see the area forecasted to develop.	**1455Z** Playbook route ORD JVL/BDF 2 has been executed. The flight crew receives notification through their PED of an ATCSCC advisory that the JVL/BDF 2 playbook issued. The flight crew opens the Playbook data information via SWIM link and reviews the route. After this review, they contact dispatch to ensure that they are able to accept the route ONL J114 GEP J106 GRB TVC WYNDE4. The dispatcher advises the flight crew they have the sufficient fuel for the reroute. The flight crew pre-programs the FMF with the route and stores it until it is issued. The flight crew then configures the PED to retrieve the convective weather forecast for ZMP/ZKC. This forecast is displayed and shows convective weather developing in the area of ONL extending south of BDF. **1510Z** PED notifies the flight crew of change to ORD. Flight crew checks the changes; route advisory for ORD has been published. Flight crew can expect ONL J114 GEP J106 GRB TVC WYNDE4 reroute, based on planning with the

Without AAtS	With AAtS
	dispatcher from the ATCSCC advisories; flight crew can accept the route. This will add 20 minutes of flying time and consume approximately 920 pounds of fuel.
1515Z ZDV clears flight to ORD via direct ONL J114 GEP J106 GRB TVC WYNDE4. The flight crew questions the controller concerning the reason for the reroute. Unsure if they can accept the reroute, the flight crew needs to check with their dispatcher before they can accept route.	**1515Z** ZDV clears the flight to ORD via direct ONL J114 GEP J106 GRB TVC WYNDE4. The flight crew accepts the clearance and programs the FMF. They then check the PED for weather and flight conditions along the reroute.
1530Z The flight crew contacts the dispatcher with questions about the reroute. The dispatcher relays information on the reroute and the weather development along the reroute to the flight crew.	**1535Z** The dispatcher has checked all passenger connections and relays this to the flight crew. The late arrival will not impact the connections.
1537Z The dispatcher advises the flight crew they can accept the reroute and that their fuel load is sufficient.	
1542Z The flight Crew advises ZDV that they can accept the reroute. Due to the delay in accepting the reroute, the flight will take an additional 17 minutes longer and require approximately 800 pounds of additional fuel. The total cost of the reroute 27 minutes and 1720 pounds of fuel, compared to AAtS flight's 10 minutes and 920 pounds of fuel, due to the altitude change earlier and pre-coordination on the reroute from the heads up from PED.	
1550Z The flight crew requests an updated weather forecast along the new route of flight. The hard copy forecast provided to the flight crew with the dispatcher	

Without AAtS	With AAtS
release is over six hours old not giving the flight crew current conditions. **1558Z** The dispatcher sends the flight crew an updated forecast, not expecting any weather along route. **1600Z** The dispatcher advises the flight crew the flight is going to be approximately 40 minutes late and passes along gate information for passengers with connections.	**1605Z** No convective weather but turbulence exists along the new route. Flight crew receives notification on the PED of turbulence along the new route. Upon review, it shows that for the remainder of the flight the aircraft will be experiencing turbulence. Before encountering turbulence, the flight crew instructs the cabin crew to cease cabin service and for everyone to remain seated for the remainder of flight.
1700Z The flight crew performs their Descent/Arrival checklist. The flight crew initiates the descent from cruse altitude into ORD.	**1640Z** The flight crew commences their Descent/Arrival checklist items. The flight crew initiates the descent from cruse altitude into ORD.
1720Z The flight lands, +20 minutes late and taxis to the still open gate.	**1700Z** The flight lands and taxis to the still open gate.

Table C3-1 – Operational Use Case Scenario 3

Demonstrated impacts from AAtS implementation

- ***Reduce impact on current system through increased situational awareness.***
    - Use of AAtS-delivered data dramatically increased the flight crew's situational awareness.
        - Learned before departure of possible reroutes into O'Hare.
        - While en route the crew was notified to clear air turbulence in Denver ARTCC airspace.
        - Anticipated playbook reroute long before ATC cleared them on new route to destination.

        - Had access to new route prior to clearance.
        - Planned for possible reroute with their AOC, made easier because of their shared situational awareness.
        - PED informed the crew of delays into destination airport prior to notification by radio from ATC.
    - Increased situational awareness reduced impact on the NAS.
        - Anticipated CAT and requested altitude change before encountering turbulence.
            - Eliminated the need for a conversation with ATC of turbulence.
            - Prevented an urgent request for solicitation of pilot reports of turbulence and the resulting rushed request for an immediate altitude change.
        - A delay in accepting a reroute was prevented through a planning discussion with their AOC on the plane's capability to fly the new routing to destination.
    - ATC could issue the flight plan, receive immediate acceptance of the new route.
        - Impact of the reroute on the system reduced through this exchange made efficient because of a raised situational awareness held by the affected flight crew.
        - An on-frequency conversation about weather conditions on new route is avoided.
        - Immediate request of turbulence reports and possible rerouting is not necessary because the crew possessed the information on flight conditions in sufficient time to research the weather and assess its impact on their flight.
- ***Reduce system delays, anticipate problems, and provide sufficient time to design workarounds.***
    - System delays were reduced by advanced information provided by AAtS.
        - The flight crew knew about the reroute plan and prepared for it, reducing the time necessary for ATC to first explain and then issue the reroute clearance.
        - Anticipating the reroute allowed the crew to coordinate with their AOC and thus eliminate a delay between the reroute issuance and acceptance by the flight crew.
        - No conversation of conditions along the new route is necessary since the AAtS-provided weather information was sufficient to have a clear picture of flight conditions.

- No surprises were encountered along the route despite complex weather and traffic conditions.
    - Information provided in time sufficient to judge the severity of conditions and assess necessary responses to these conditions led to an orderly and effective decision-making process for the flight crew.
        - The result was a crew with enough information delivered early enough to advise passengers, their AOC, and ATC of both what was to be experienced and to design workarounds.

- ***Increase information exchange between flight crews and air traffic control, provide real-time information to flight crews, and eventually reduce frequency congestion.***
    - The information exchange between ATC and the flight crew was made more efficient and effective.
        - The crew anticipated ATC clearances in response to flight conditions, lessening the chance for misunderstanding, questioning the need for reroutes or altitude changes, or the threat of missed information.
        - ATC is less likely to have to repeat clearances or for communication to be misunderstood
            - The flight crew already knows the context of the communication.
        - ATC can concentrate on essential information.
            - AAtS delivery of information via a non-essential channel frees ATC to focus more on essential information.
        - Frequency congestion is reduced.
            - As AAtS diverts non-essential information to an alternative communication channel, ATC may need to deliver less but more essential information via the radio, lessening the risk of frequency congestion.
    - Increased information exchange provides the flight crew with a context to information delivered by radio.
        - Context lessens the threat of misunderstanding information.
        - A shared context can shorten messages, allowing more messages to be broadcast.
        - A shared context provides the means for a more collaborative environment

Appendix C.4 – Operational Use Case Scenario 4

Domestic General Aviation (GA) flight – (Special Event Flight VMC changing to IMC)

Purpose

This use case will explore the use of AAtS by a private GA operator. This use case will explore the operation of multiple flights by a single aircraft into and out of where a special event is scheduled to take place, (super bowl). This use case scenario presents a general aviation flight with no Flight Operations Center (FOC) support. It relies solely on airborne support called "flight following, provided by a Flight Service Station (FSS). With near real-time presentation of airport demand information, companies and airlines can plan their flights to the general destination more efficiently.

Goal(s)

- Demonstrate the use of AAtS and the benefit by GA flight crew.
- Understand the benefits of AAtS for use during special event.
- Explore the benefits to a flight crew with no AOC/FOC support.
- Provide greater awareness of rapidly changing conditions, during a special event.

Scenario background description

Cessna N220ND, C650 (Citation III) is a private company jet with a flight department consists of two pilots, the Captain and a FO; one-person office staff and a one-person ground crew, serving as the mechanic, ramp attendant and fueling aircraft. The flight crew does not have the benefit of a scheduling department or an FOC. They rely on a pay per use flight planning service that allows them to call in or use an online service to flight plan or make changes to future flight plans and limited weather briefings. The company's Citation will be making two trips from the Chicago area to Indianapolis (IND) for the Super Bowl to drop off passengers. The aircraft will be overnighting in the area and making return trips the following day. The flight crew has two Special Traffic Management Programs (STMP) requests for the flights into IND area. The flight crew has filed IFR flight plans for all legs for the day. The first flight's filed routing is PWK EON V399 KENLA V128 JELLS IND at an altitude of FL210 scheduled to depart at 1400Z a 1 hour and 20 minute flight. The flight plan route will be conducted through the following facilities: Pewaukee (PWK)/Chicago TRACON (C90)/Chicago ARTCC (ZAU)/Indianapolis ARTCC (ZID)/Indianapolis TRACON (IND), and Indianapolis Tower (IND). STMPs are needed to control the volume into IND area airports normally not seeing a great deal of volume. STMPs are for GA into the IND area and not set for a single airport. Normally scheduled airline traffic and flights based at the STMP airports are exempt from the program. Weather at IND may be a factor throughout the day and may require a ground delay program. Once the aircraft takes off, the only support the flight crew has is provided by the FSS. NOTAM for routes into Super Bowl airports has been published.

Route and MIT restrictions are in effect for all flights into Indianapolis ARTCC (ZID) throughout the day in anticipation of increased traffic due to the Super Bowl event. The morning traffic volume at IND is expected to reach capacity and if weather impacts the area a GDP will be required. The flight is not expecting to be impacted by any problematic events in the NAS. ATCSCC has established a position to manage Super Bowl operations.

Flight Planning

1250Z - The flight crew carries out the Clearance briefing

The flight crew receives a weather briefing from FSS. The flight crew configures the PED device to trigger the retrieval of any updates for IND and enters a request via the PED for forecast weather that may affect the planned route and requested altitude. The meteorological information is tailored to the flight trajectory and flight times and information is received and displayed to the flight crew showing favorable weather and winds along the filed route within the specific times, IFR weather in the IND area may impact all the airports later. The flight crew then requests the PED to retrieve and display detailed aeronautical information for IND including NOTAMs and instrument approaches.

The flight crew proceeds to review the PED for current departure delays out of C90 and the current operational plan for any potential system impacts en route, delays, and reroutes and checks for TMIs in effect at IND.

With all pertinent flight information and updates reviewed and briefed, the flight crew contacts the ground control/clearance delivery at PWK and requests a clearance to IND.

The flight's STMP time into IND is 1520Z the flight needs to be airborne by 1400Z to meet the STMP time into IND.

Push Back / Taxi (Ground Movement)

1345Z - The aircraft taxi to their assigned departure runway.

The FO contacts ground control for taxi clearance taxis the aircraft to the departure runway and switches the frequency to Tower (ATCT) for takeoff clearance.

Takeoff / Climb

1355Z - The aircraft takes off.

The flight is cleared for takeoff, the aircraft rolls down the departure runway and commences initial climb. Tower instructs the flight crew to contact Chicago departure control (C90); the aircraft departs C90 terminal airspace without incident and reaches cruising altitude 15 minutes later.

En Route Cruise

1410Z - The flight has reached cruising altitude of FL210 and PED notification the flight crew airborne holding into IND.

Airborne holding has just been initiated for arrivals into IND terminal airspace.

The flight crew receives airborne holding instructions at JAKKS intersection with EFC 1500Z IND.

AAtS flight crew is aware holding is expected to be 15 – 20 minutes and will still be on schedule for return flight to Rockford, IL.

Non – AAtS flight crew cannot accept holding based on the information that they have and makes the decision to change and land at Eagle Creek, (EYE). Flight is re-cleared to EYE.

1425Z – AAtS Flight is cleared out of holding to IND.

Descent / Arrival

1455Z – Non-AAtS flight crew begins descent into EYE.

FO is coordinating with limo service to move from IND to EYE to pick up passengers, also needs to amend flight plan to depart EYE and not IND.

The flight crew commences their Descent/Arrival checklist items.

1510Z – AAtS flight crew begins their descent into IND.

The flight crew commences their Descent/Arrival checklist items.

Approach / Landing

1530Z Non-AAtS flight lands at EYE limo is not at the airport.

1540Z – AAtS flight lands, passengers disembark at the FBO and the flight crew programs the FMF and they perform their cockpit checks for the outbound leg.

Return trip to RFD Flight Planning

1545Z - Flight is at IND, flight plan is on file and flight crew has pre-briefed on the inbound leg.

Non-AAtS flight crew revises their flight plan to depart from EYE instead of IND. Flight crew contacts FSS to check NOTAMs for restrictions on departing from EYE.

Push back / Taxi

1600Z - AAtS flight contacts Ground Control (GC) for taxi.

Non-AAtS contacts IND TRACON to request departure clearance; flight crew is given the clearance but told to hold for release for traffic – expect a 15 minute delay.

Takeoff / Climb

1615Z - AAtS flight is airborne at altitude

Non-AAtS flight is taking the runway for departure

Domestic En Route Cruise

1720Z - AAtS flight is notified by PED of General Aviation Airport Program (GA) at IND due to reduced Airport Arrival Rate (AAR) - average delay 35 minutes.

The flight crew contacts FSS to see if their flight planned into EYE would they incur a delay, FSS advises that there would be no delay into EYE. Flight crew contacts passengers at the RFD FBO to confirm what they prefer, a delayed flight into IND or an on time flight to EYE. Passengers request to go on time to EYE.

Non-AAtS flight is unaware of the General Aviation Airport Program GAAP or its impact on the flight.

1730Z - AAtS flight crew contacts the flight planning service to change the flight plan into EYE and contacts the limo service to meet the flight at EYE.

NOTE: *the impact on the non-AAtS flight would continue to compound delays if scenario was continued.*

Table C4-1 Operational Use Case Scenario 4 provides a side-by-side comparison of operations without AAtS, given this scenario, compared to a flight with AAtS operations to highlight proposed benefits.

Without AAtS	With AAtS
1250Z Flight crew performs the Clearance Brief	**1250Z** Flight crew performs the Clearance Brief The flight crew configures the PED device to trigger the retrieval of any updates for IND and enters a request via the PED for forecast weather that may affect the planned route and requested altitude. The meteorological information is tailored to the flight trajectory and flight times and information is received and displayed to the flight crew showing favorable weather and winds along the filed route within the specific times, IFR weather in the IND area may impact all the airports later. The flight crew then requests the PED to retrieve and display detailed aeronautical information for IND including NOTAMs and instrument approaches. The flight crew proceeds to review the PED for current departure delays out of C90 and the current operational plan for any potential system impacts en route, delays, and reroutes and checks for TMIs in effect at IND.
1345Z The FO contacts ground control for taxi clearance, taxis to the departure runway and switches the frequency to Tower (ATCT) for takeoff clearance.	**1345Z** The FO contacts ground control for taxi clearance, taxis to the departure runway and switches the frequency to Tower (ATCT) for takeoff clearance.
1355Z The flight is cleared for takeoff, the aircraft rolls down the departure runway and commences initial climb. Tower instructs the flight crew to contact Chicago departure control (C90); the aircraft departs C90 terminal airspace without incident and reaches cruising altitude 15 minutes later.	**1355Z** The flight is cleared for takeoff, the aircraft rolls down the departure runway and commences initial climb. Tower instructs the flight crew to contact Chicago departure control (C90); the aircraft departs C90 terminal airspace without incident and reaches cruising altitude 15 minutes later.
	1405Z PED notifies the flight crew of the airborne holding into IND; expected to be 15 to 20 minutes. The flight crew starts looking at their time

Without AAtS	With AAtS
1410Z The fight crew is issued holding EFC 1500Z Flight crew starts looking at their time schedule. They have 60 minutes to do a quick turn to get back to RFD for the second group. Due to the schedule, the flight crew talks with the passengers and change their destination to EYE. The flight crew cannot accept airborne holding of 60 minutes and makes the decision to change and land at Eagle Creek, (EYE). The flight crew is re-cleared to EYE. The FO is coordinating with limo service to move from IND to EYE to pick up passengers, also needs to amend flight plan to depart EYE and not IND.	schedule; they have 60 minutes to do a quick turn to get back to RFD for the second group. Holding up to 30 minutes will still allow the flight crew to make RFD in time for the return flight. **1410Z** The flight crew is issued holding instructions with an EFC of 1500Z **1425Z** The flight crew is cleared out of holding and continues to IND **1445Z** Update on the PED current airborne holding is only going to be +20; also because of reduced AAR the ATCSCC is planning to G/S into a GAAP program for IND
1455Z The flight crew commences their Descent/Arrival checklist items.	**1510Z** The flight crew is cleared out of holding and continues to IND The flight crew commences their Descent/Arrival checklist items.
1455Z The flight lands at EYE, passengers have LIMO to IND to meet customers at FBO will be late for meeting **1530Z** The flight crew has landed at EYE limo is not at the airport. The flight crew is waiting for limo the passengers are still on the aircraft.	**1540Z** The flight lands at IND without problem. The limo is waiting for the passengers at the FBO.
1545Z The flight crew contacts their	**1545Z** The flight crew reviews PED for current weather, TMIs and the Super

Without AAtS	With AAtS
flight planning service to change their flight plan from departing IND to depart EYE landing RFD. The flight crew contacts FSS for a weather briefing and an update on current TMIs	Bowl status board for IND updates **1600Z** The flight crew is notified by PED that a GAAP program for IND expected to be out about 1615Z
1600Z FO contacts IND TRACON to request departure clearance; flight crew is given the clearance but told to hold for release for traffic – expect a 15 minute delay.	**1600Z** FO contacts Ground Control (GC) for taxi.
1615Z The flight is released from EYE, clearance void at 1630z.	**1615Z** The flight is cleared for takeoff.

Table C4-1 – Operational Use Case Scenario 4

Demonstrated impacts from AAtS implementation

- ***Reduce impact on current system through increased situational awareness.***
  - Use of AAtS-delivered data dramatically increased the flight crew's situational awareness.
    - Learned before departure of possible reroutes into O'Hare.
    - While en route the crew was notified to clear air turbulence in Denver ARTCC airspace.
    - Anticipated playbook reroute long before ATC cleared them on new route to destination.
    - Had access to new route prior to clearance.
    - Super bowl status board informed the crew of delays into destination airport prior to notification by radio from ATC.
  - Increased situational awareness reduced impact on the NAS.
    - Anticipated CAT and requested altitude change before encountering turbulence.
      - Eliminated the need for a conversation with ATC of turbulence.
      - Prevented an urgent request for solicitation of pilot reports of turbulence and the resulting rushed request for an immediate altitude change.

        - A delay in accepting a reroute was prevented through a planning discussion with their AOC on the plane's capability to fly the new routing to destination.
            - ATC could issue the flight plan, receive immediate acceptance of the new route.
        - Impact of the reroute on the system reduced through this exchange made efficient because of a raised situational awareness held by the affected flight crew.
        - An on-frequency conversation about weather conditions on new route is avoided.
        - Immediate request of turbulence reports and possible rerouting is not necessary because the crew possessed the information on flight conditions in sufficient time to research the weather and assess its impact on their flight.
- ***Reduce system delays, anticipate problems and provide sufficient time to design workarounds.***
    - System delays were reduced by advanced information provided by AAtS.
        - The flight crew knew about the reroute plan and prepared for it, reducing the time necessary for ATC to first explain and then issue the reroute clearance.
        - Anticipating the reroute allowed the crew to coordinate with their AOC and thus eliminate a delay between the reroute issuance and acceptance by the flight crew.
        - No conversation of conditions along the new route is necessary since the AAtS-provided weather information was sufficient to have a clear picture of flight conditions.
    - No surprises were encountered along the route despite complex weather and traffic conditions.
        - Information provided in time sufficient to judge the severity of conditions and assess necessary responses to these conditions led to an orderly and effective decision-making process for the flight crew.
            - The result was a crew with enough information delivered early enough to advise passengers, their AOC, and ATC of both what was to be experienced and to design workarounds.
- ***Increase information exchange between flight crews and air traffic control, provide real-time information to flight crews and reduce frequency congestion.***

- The information exchange between ATC and the flight crew was made more efficient and effective.
    - The crew anticipated ATC clearances in response to flight conditions, lessening the chance for misunderstanding, questioning the need for a reroutes or altitude changes, or the threat of missed information.
    - ATC is less likely to have to repeat clearances or for communication to be misunderstood
        - The flight crew already knows the context of the communication.
    - ATC can concentrate on essential information.
        - AAtS delivery of information via a non-essential channel frees ATC to focus more on essential information.
    - Frequency congestion is reduced.
        - As AAtS diverts non-essential information to an alternative communication channel, ATC may need to deliver less but more essential information via the radio, lessening the risk of frequency congestion.
- Increased information exchange provides the flight crew with a context to information delivered by radio.
    - Context lessens the threat of misunderstanding information.
    - A shared context can shorten messages, allowing more messages to be broadcast.
    - A shared context provides the means for a more collaborative environment.

APPENDIX D – TRACEABILITY MATRIX

The traceability matrix provides a cross-reference between systems functions and operational activities to help ensure that:

- Each operational activity has an implementing system function.
- Each system function supports an operational activity, (i.e. an operational requirement).

System Functions	Operational Activities		
	Provide Aeronautical Information	Provide Air Traffic Management Information	Provide Weather Information
Maintain Data Synchronization Between Ground and Aircraft Users	X	X	X
Maintain Secure Communications	X	X	X
Manage Data Filter Configuration	X	X	X
Manage Data Links	X	X	X
Manage Security Service	X	X	X
Manage Subscription / Data Request Configuration	X	X	X
Manage Subscription / Data Request Rules	X	X	X
Manage Synchronization Rules	X	X	X
Monitor / Report Network Performance	X	X	X
Monitor Data Synchronization	X	X	X
Perform Compression / Expansion of Data	X	X	X
Perform Data Acquisition Service			
Perform Data Filtering Service	X	X	X

System Functions	Operational Activities		
	Provide Aeronautical Information	Provide Air Traffic Management Information	Provide Weather Information
Perform Data Validation	X	X	X
Perform Protocol Translation	X	X	X
Populate Priority and Security Data Fields	X	X	X
Provide Core Services	X	X	X
Provide NAS Enterprise Security Gateway Service	X	X	X
Publish Aeronautical Data	X		
Publish ATM Data		X	
Publish Weather Data			X

APPENDIX E – COMMENTS AND RESOLUTION MATRIX

Reviewer	Section#, Paragraph#, Line#, sentence#, page#, figure#, table#	Comment	Recommended Solution
Garret Livack	First page.	Per an earlier concern, your AAtS document needs to be harmonized (prior to Version #2) with the European vision of SWIM / AAtS. See the Eurocontrol SWIM/AAtS Action Plan. Its focus is to mature their SWIM Concept. An approved version was released June 2012. Their doc defines SWIM/AAtS and how it might be used. As a result of their SWIM ConOps work, their definition of SWIM is as follows: SWIM / AAtS concept consists of standards, infrastructure and governance rules enabling the management of ATM information and its exchange between qualified parties via interoperable services. But, here's the issue: How does your doc differ from their document, OPERATIONALLY? Their SWIM vision is certainly not a "big-bang" replacement of the existing ATM environment, but, rather, an evolutionary process based on a gradual transition towards a service-oriented ATM system. But, the Global SWIM / AAtS must interact in an interoperable and standardized way. The current version of SWIM ConOps is available at... http://www.eurocontrol.int/sites/default/files/content/documents/information-management/del08.01.01-d40-swim_conops.pdf	See new language in section 1.3.2.4 on global harmonization -- AAtS Concept Overview section (objectives).

Reviewer	Section#, Paragraph#, Line#, sentence#, page#, figure#, table#	Comment	Recommended Solution
Garret Livack	Section 1.3.2.1, first paragraph, fourth line	Wind and temp and turb data into FMF. In or out of scope?	Assuming the services used to deliver this data meet the performance characteristics necessary for the intended use? Then Yes in scope Adjudicated. Added the following text to section 2.2: Examples of non-trajectory affecting information include wind, temperature and turbulence information for presentation to the pilot or upload into the flight management function (FMF) assuming the services used for delivering that information meet the performance characteristics necessary for supporting the intended use.
Roger Sultan	Section 2.2, fourth paragraph	Who is providing the weather data to SWIM? What happens if the weather data from AAtS differs from the approved weather data authorized for the specific user?	Note the change in wording.
Roger Sultan	Section 2.3.1, first paragraph, last sentence.	Will FAA contract out for weather data and offer a suite of products similar to FIS-B? Or will FAA port a suite of NWS products? Or is there another option?	See language referring to no FAA funded implementation of AAtS. Refer to CSS-WX concept for what weather data will be available via SWIM. See also ITWS, WARP, CIWS and E-WIN data services for weather data potentially available via SWIM.
Gregory Borsari	Section 2.3.1, first paragraph, last sentence.	Would nexrad mosiacs be included?	Sure. See WARP.
Roger Sultan	Section 2.3.3, fourth paragraph	No requirement for 135 to use an AOC, this is not a correct statement.	Changed it to “14 CFR Part 21”.
Gregory Borsari	Section 2.4.2, Table 2-3, third row (Aircraft Systems)	Class 1 & 2 EFB are considered portable devices and not part of the type design or supplemental design and therefore are not part of the aircraft systems. Only class 3 that fully installed are considered as part of the aircraft system, ref. AC 120-76A.	Renamed “Aircraft Systems” to Aircraft Access to DMS”.
Garret Livack	Section 2.4.2, Figure 2-3	Need to archive data. How do you do that? Where in this architecture? Also, can you use this architecture to reduce threat of cyber attacks	However, is the need for archival of data an AAtS guidance issue or an overall data link issue? If the former, we will include. If the latter, it is out of scope.

Reviewer	Section#, Paragraph#, Line#, sentence#, page#, figure#, table#	Comment	Recommended Solution
Roger Sultan	Section 3.0, fifth paragraph, fourth line.	Will operational approval include AIR approval or only AFS as normally AFS is the entity that gives Operational Approval?	Operational approval from AVS depends on the intended use. There will be different kinds of operational approvals (e.g., AIR approval, consuming data from SWIM approval, etc). Perhaps a better term then operational approval? One that encompasses the AFS role and the AIR role.
Garret Livack	Section 3.1.2.1, Internet-Based section	In English... Can I use 3G / 4G / LTE to connect my iPad to the web to download BSS and AUS data?	Assuming the iPad connects to a server which connects to the NESG then yes. The “Internet Based” connection this refers to is only referring to the connection between the NESG and the DMS. What you are referring to is the connection between the Aircraft Access to DMS and the DMS. A different section. See section 3.1.2.2
Roger Sultan	Section 3.2.1, second paragraph	91 issue again, no regulation to enforce this on 91, thus no operational approval process.	See edited text to specify an applicable operation. So if a corporate flight department wishes to implement category 1 services, there will be no oversight from the FAA?
Gregory Borsari	Section 3.2.1.1.2.2, Table 3-1, fourth row	You have a section for lost data. We may need to add a section for corrupted data as well.	Corrupted data is not a validation element. That said, we will add it in the performance section. 3.2.1.6.
Gregory Borsari	Section 3.2.1.1.2.2, Table 3-1, fourth row	Do we explain the differences between broadcast, demand and contract in this guidance? Or point to something that does? For broadcast data how would you monitor lost data? Does this only apply to demand and contract?	Lost data applies to all modes. We added definitions of broadcast mode, demand mode, and contract mode to the glossary. Additionally we refer to the various RTCA documents that do refer to it.
Gregory Borsari	Section 3.2.1.2	Unless the system is entirely portable a change to the aircraft type design is required in order to enable this capability. The standards either need to be identified and/or created and we should recognize that need.	The system function name has been changed from “Aircraft Systems” to “Aircraft Access to DMS”.
Gregory Borsari	Section 3.2.1.3.1, second paragraph	I too still get caught up in the FAR part even though we long ago changed to CFR	Changed “FAR” to “CFR” in the paragraph.

Reviewer	Section#, Paragraph#, Line#, sentence#, page#, figure#, table#	Comment	Recommended Solution
Garret Livack	Section 3.2.1.3.1, second paragraph	It is unclear how AAtS will ensure that airborne data is harmonized with ATC & AOC data, obtained from the same NESG gateway.	It is our responsibility (scope) to define the means to get aircraft to access the common data platform and provided a synchronization means with the AOC. The requirements to get the ATC into the same loop are outside of our scope.
Roger Sultan	Appendix B	To simplify this document, the definition should include 91K, 121, 125, 125 LODA Holders, and 135....not 91 corporate or GA PIC.	Resolved through definition edit of Aircraft Operator
Garret Livack	Appendix B	Define AFS, AIR and AOV	AFS, AIR and AOV have been defined in the appendix.
Roger Sultan	Appendix C, third section, Procedural Assumption	Better term may be guidance, but as Greg states, the document should state specifics.	Changed “Procedural Assumptions” to “Guidance Assumptions”.
Gregory Borsari	Appendix C.1, Domestic En Route Cruise section, page 84	The PED notifies the flight crew?! Really?! This sounds like a contract is in place requesting updates on turbulence or at a minimum a onetime request (demand) The PED notifying the flight crew is found in other scenarios as well. Would suggest something like the flight crew gets an update through their portable EFB (See how the assumptions up front was for an EFB or EFB like device to connect with SWIM) Just something to consider.	The flight crew gets an update through a portable EFB notifying them that there are PIREPs of moderate turbulence along the current flight route at their altitude.
Roger Sultan	Appendix C.3, Descent/Arrival, Weather data sub-section	Big assumption that crew is seeing CIWS...this is not a normal product for flight crews...if you want to go in that direction, go with COSPA.	Flight crew reviews weather information to see if the convection forecast has changed.
Gregory Borsari	Section 3.2.1.6.2, fist paragraph	Add data corruption and data loss	Added data corruption and data loss to the section.