

AIRCRAFT ACCESS TO SWIM – A COLLABORATIVE ATM PATHFINDER TO SUPPORT A TBO ENVIRONMENT

Robert Klein, Biruk Abraham, and Angel Morales, FAA, Washington, DC

Kevin Niewoehner, Farid Aknine, and John Pace, North Star Group LLC, Washington, DC

Abstract

The NextGen National Airspace System (NAS) has begun to take shape with the functional emergence of En Route Automation Modernization (ERAM) and the Terminal Automation Modernization and Replacement (TAMR). NextGen Programs include:

- 1) Automatic Dependent Surveillance-Broadcast (ADS-B);
- 2) Collaborative Air Traffic Management Technologies (CATMT);
- 3) National Airspace System Voice System (NVS);
- 4) NextGen Weather;
- 5) Data Communications (Data Comm); and
- 6) System Wide Information Management (SWIM).

These programs are being implemented to transform the operational precepts of the NAS, as based currently on ground control of aircraft separation. The NextGen programs will fundamentally change the NAS operational framework from a voice-centric to a data-centric model. The new model will rely extensively on air-ground operational integration coupled with ready-access to communication, navigation and surveillance (CNS) data to enable 4-dimensional trajectory-based-operation (4DT) flow management.

In addition to these advanced-development NextGen programs, the FAA has sponsored a pathfinder initiative to enable flightcrew access to SWIM data for enhanced shared situational awareness, (SSA). This pathfinder, known as Aircraft Access to SWIM (AAtS), has organized itself within a broad framework of public/private collaboration (government & industry partnership) focused on the coupled evolution of air-ground-integration and related enabling technologies.

As a pathfinder, the AAtS operational paradigm is consistent with the U.S. vision for SWIM. The

solution developed focus on connecting SWIM to aircraft. Other air-service regions are considering different concepts, architectures and requirements for SWIM-aircraft connectivity and are targeted for later dates for entry into service.

The AAtS initiative has developed:

- an operations concept;
- technical implementation framework; and
- conducted operational demonstrations.

These establish a proof-of-concept benchmark for implementation of a collaborative decision making (CDM) capability. The AAtS pathfinder environment leverages existing systems and new communications infrastructure, including broadband IP and COTS technology (see Figure 1).

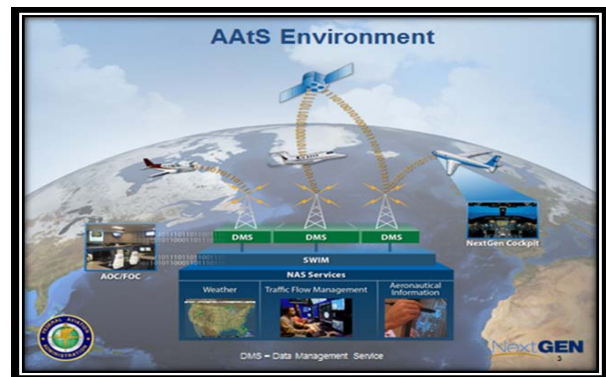


Figure 1. AAtS Environment

The Phase 1 Demonstration looked at one-way broadcast to the flight deck using an IP data exchange framework employing both terrestrial and space-based communication systems. Phase 1 provided valuable insight to the quantitative bandwidth usage and transmission package sizes for pertinent flight planning data. Qualitative results from the Phase 1 demonstrations included processing of data and information sets useful to the flightcrew as well as operational assessments of the

AAtS Demonstration Program

Demonstration data promoted better understanding of:

- 1) usage patterns for available products;
- 2) system-level performance;
- 3) utility of the demonstrated data links;
- 4) data protocol efficiency;
- 5) communication issue mitigation; and
- 6) potential performance improvements through lessons learned.

Phase 2 will demonstrate air-to-ground communications in addition to the ground-to-air exchange from Phase 1. The Phase 2 demonstrations will measure operational systems performance, with an eye toward how best to facilitate CDM among the ATC, flightcrews, and the aircraft operations center (AOC). Data from resulting operational improvements will illustrate system efficiencies to be harvested through CDM.

Air-ground integration within the realm of 4DT data exchange schema promises to yield material system efficiencies, especially as they apply to route optimization and accommodation of transient disruptions, e.g. traffic or weather induced flow upsets. The AAtS initiative will shed light on the nature of the expected efficiencies in addition to issues pertaining to system-safety and information security. AAtS, as a pathfinder, is well underway and has spurred significant future-systems architectural development within individual avionics original equipment manufacturers (OEMs) in addition to collaborative development OEM teams.

The future of AAtS is to build on a premise that SWIM services can produce a benefit for the operators and FAA thru CATM. As a result, CATM via AAtS will enable improved airspace usage as part of a broader connected aircraft strategy. The belief is that air traffic management and connected aircraft will benefit from increased situational awareness, combined with their ability to expeditiously formulate operational solutions working with controllers and company dispatchers. To become viable from a business perspective, AAtS must yield material benefit through cost avoidance in the air and during ground operations.

Introduction

NextGen is the transformation of how aircraft operate within the National Airspace System (NAS), and more specifically how they interact with other aircraft, air traffic controllers, and the automation systems that coordinate traffic through high-density flow corridors.

Principal among the operational evolution of the NAS is the emergence of optimized trajectory-based-operations or TBO. Air traffic controllers manage current NAS operations through air-navigation service locations at airport control towers, terminal radar approach control facilities, (i.e. TRACONs) and air-route traffic control centers, (i.e. ARTCCs). These facilities ensure aircraft separation in the NAS by providing the operational control linkage between ground-based surveillance systems and operational clearances for specific aircraft being operated by airlines, businesses, and individuals.

NextGen is ushering in a new era of flight and will soon evolve from operations based on terrestrial navigational aids (NAVAIDS), to 4-dimensional TBO (4DT) that utilize precision GPS position references. The NextGen NAS has begun to take shape with the functional emergence of En Route Automation Modernization (ERAM) and the Terminal Automation Modernization and Replacement (TAMR). NextGen transformational Programs [1] include:

- 1) Automatic Dependent Surveillance-Broadcast (ADS-B);
- 2) Collaborative Air Traffic Management Technologies (CATMT);
- 3) Data Communications (Data Comm);
- 4) National Airspace System Voice System (NVS);
- 5) NextGen Weather; and
- 6) System Wide Information Management (SWIM).

These programs are being implemented to transform the operational precepts of the NAS, as based currently on ground control of aircraft separation. The NextGen programs will fundamentally change the NAS operational framework from a controller-centric model that is reliant on voice communications to a more automation-centric model. The new model will rely

extensively on air-ground operational integration coupled with ready-access to communication, navigation and surveillance (CNS) data to enable 4-dimensional trajectory-based-operations (4DT) with traffic flow management.

Within NextGen the FAA has sponsored a pathfinder initiative to enable flightcrew access to SWIM data for enhanced shared situational awareness, (SSA). This pathfinder, known as Aircraft Access to SWIM (AAtS), has organized itself within a broad framework of public/private collaboration (government & industry partnerships) focused on the coupled evolution of air-ground-integration and related enabling technologies.

AAtS takes the first intuitive steps beyond command-and-control paradigms of ATC, toward broadband internet protocol (IP) integration of the thousands of airborne flightcrews with a distributed network of systems and information, (i.e. SWIM). These IP-based data and information exchanges will take place through the utilization of terrestrial and space-based broadband communication networks.

These later evolved into the initial operations concept for a collection of systems and services that were broadly characterized as the aircraft access to SWIM (AAtS). The system's concept has evolved from a standalone development effort to an open-architecture schema aimed at a federated marketplace of data-management-service providers or information-product bundlers. As such, AAtS serves as an FAA pathfinder for these service providers and includes the basic system components necessary to exchange certain data products, e.g. weather maps, NOTAMs, and PIREPs.

Background

Operational Strategy

AAtS will enable enhanced two-way information exchanges between flight operators; particularly, the aircrew and FAA operational personnel to support strategic planning. In particular, AAtS enables the flight crew to become a more active participant in collaborative decision making. As a result of access to increased information, both flight operators and FAA operational personnel can make improved decisions. The AAtS concept is applicable to all flight operation domains, including pre-departure, airborne, arrival, and post-arrival

phases. It is applicable to all flights, whether supported or not supported by dispatch, but flight operator participation in AAtS is not mandatory. AAtS cannot be used to exchange command and control information.

The AAtS data management service (DMS) will be used by the flights to enable the exchange of information with SWIM via IP data link. Since AAtS is not intended to be used to exchange control information or a primary method to exchange safety-critical information, relatively inexpensive commercially or internally developed applications will be introduced and be fully leveraged to access and display this information.

AAtS will enable a new communication flow between traffic managers and pilots. Traffic managers can use AAtS to solicit information from pilots such as PIREPs and reroute preferences. Traffic managers can use this information to increase their situational awareness and improve decision making. For flights not supported by dispatch, AAtS increases the amount of information available to the aircrew while on board the aircraft, effectively widening the knowledge aperture of the aircrew and enabling more informed decision making. For flights supported by dispatch, AAtS will enable the aircrew to receive additional information beyond what is typical today. As the aircrew is better informed, the decision-making process involving aircrew and aircraft dispatcher will evolve.

Increased digital sharing of flight status and user preferences will improve the accuracy of demand predictions and will facilitate collaborative and continuous TFM decision making. Automated submission of aircraft atmospheric sensor data will improve the quality of weather forecasts and the meteorological information that is used by FAA automation systems, resulting in improved operational decisions.

Technical Schema

The AAtS initiative is one of many activities being explored under NextGen to identify new aviation capabilities which will incorporate flight crews in the collaborative decision making process throughout all phases of flight. AAtS will leverage functions and capabilities implemented under the FAA's SWIM program. The SWIM program is one of six transformational programs within the NextGen

portfolio and is designed to utilize a Service Oriented Architecture (SOA) to exchange aviation data and services.

SWIM supports the integration of NAS Services by providing a platform that allows information exchanges between NAS programs and external entities. The types of data that can be exchanged include air traffic management information, aeronautical information, and weather data. Examples of air traffic management information include flow information, traffic management initiative (TMI) information, and playbook information. Examples of aeronautical information include information such as notices to airmen (NOTAMs), flight restrictions, special use airspace, etc. Examples of weather information include METARs, TAFs, and PIREPs.

The NextGen Program organizes new capabilities under numerous operational improvements (OIs). These OIs link to any number of infrastructure investments that will ultimately yield 4DT operations in the NextGen NAS. A subset of these OIs addresses SWIM developmental enhancements, and their respective couplings to other NAS systems and operations. AAtS enables the aircrew to participate in CDM by enabling information exchange with ATM systems via SWIM. This capability supports the OIs *shown in Table 1*.

Table 1. OIs that AAtS Will Support

OI Number	Description	Start	Complete
101102	Provide Full Flight Plan Constraint Evaluation with Feedback	2013	2018
103305	On-Demand NAS Information	2013	2018
105207	Full Collaborative Decision Making	2017	2023
105302	Continuous Flight Day Evaluation	2012	2018
108212	Improved Management of Special Activity Airspace	2012	2017

AAtS closes the operational gap between air traffic management and pilots by connecting aircraft and flight crews to ground air traffic management (ATM) to facilitate collaborative decision making during all phases of flight and ground operations. Command and control decisions (e.g., clearances and instructions) will be performed using higher criticality communication services such as VHF voice radio or Data Communications (DataComm).

Methodology and Approach

Development of the AAtS concept followed a structured investigation and methodology process. The process included:

- 1) Reviewing the existing AAtS research studies, analysis reports, and discussions with the FAA stakeholders;
- 2) Building the architecture products in accordance with the NAS Integrated Systems Engineering Framework (ISEF). The products selected for this architecture are based on the RTCA SC-206 Architecture Recommendations Document [2]. They are designed to describe the AAtS functional and system environment in sufficient detail to ensure completeness and rigor resulting in a final product that will enable an external user to connect aircraft to SWIM and interact with NAS Services in an uplink/downlink manner.
- 3) Consulting subject matter experts (SMEs) on topics related to technical concepts, policies, security concerns, standards harmonization, global interoperability, and regulatory guidance that will impact the AAtS initiative and its potential implementation; and
- 4) Organizing quarterly AAtS Working Group (AWG) meetings to assemble a group of industry individuals, FAA representatives, and other stakeholders to proactively participate in the evolution and validation of AAtS concepts. AWG membership includes those participants interested in regulating, leveraging, implementing or using AAtS operationally.

The FAA completed the following elements as their approach to investigate the concept of AAtS.

An Operations Concept

The AAtS concept has been developed through a series of operational and technical analyses and user activities. The initial concept and related analysis focused primarily on the uplink of information to the aircraft. A follow-on effort was initiated to include the downlinked information from the aircraft that can be used by FAA operational personnel to make improved decisions. A new set of operational gaps were identified including information that could be provided through AAtS that currently is, or is expected to be useful to the aircraft or to the FAA. In order to validate the gaps and refine the concept, a series of stakeholder engagement sessions were held with program leads, FAA personnel, flight operators and pilots. As a result, the gap analysis was revised and the AAtS Concept of Operations (ConOps) dated 29 December 2014, has been refined to provide the operational context for the full information exchange. The concept continues to be reviewed by user groups.

Technical Implementation Framework

The Implementation Guidance Document (IGD) dated 31 March 2015 [3] provides the requisite set of guidance to the aircraft operator/aviation industry based on lessons learned through the demonstrations and interaction with regulators. A major concern of successful implementation of AAtS is ensuring reliable and secure communications between aircraft and SWIM. In response to this concern, FAA has sponsored Embry Riddle Aeronautical University (ERAU) to research the various threats and weaknesses that may impede AAtS effectiveness. This research resulted in several findings. In addition, harmonization of standards has been researched through RTCA SC-206, Air-Ground Information Exchange (AGIE), and Open Geospatial Consortium (OGC). Furthermore, phase 1 demonstrations were executed via ERAU to provide lessons learned and proof of concept for AAtS.

Operational Demonstrations

The Demonstration Requirements Document (DRD) provides the information/functional requirements to demonstrate the AAtS proof of concept using airline and corporate partners executing many of the AAtS operational functions

during normal flight operations. The outputs will be used as inputs in defining/refining the AAtS concepts and allowing the FAA/aviation community to understand the operational and technical benefits that can be derived from implementing AAtS domestically and establishing global interoperability. Plans for conducting live operational demonstrations of using AAtS to make information available to the aircraft have been defined and demonstration of one-way information exchange via Internet Protocol (IP) Data Link has been completed. Plans for defining live operational demonstrations of making aircraft-derived information available to the FAA via AAtS are underway.

Outreach Process

AAtS implementation will contribute to a common or shared situational awareness environment so flight crews can be involved in the collaborative decision making process. The outreach process has been structured as follows.

AAtS Working Group

The AWG was organized to serve as a discussion forum for ideas regarding operational, technical, and other related AAtS information. AAtS concepts are expected to benefit from these AWG discussions through the evolution and validation of use cases and operational scenarios. These products were instrumental in the creation and validation of technical concepts which could provide the underpinning of the AAtS business case.

AAtS Operational Demonstrations

The NextGen ERAU Advanced Research (NEAR) Lab, under sponsorship by the FAA, and in cooperation with avionics original equipment manufacturers (OEMs), and aircraft operators conducted the AAtS Phase-1 operational demonstrations. The purpose of these demonstrations was to conduct technical proof-of-concept flights and to demonstrate the potential value of AAtS to multiple aircraft operators. Throughout the demonstrations, quantitative and qualitative data was collected on usage patterns for available products, system-level performance, utility of the demonstrated data links, data protocol efficiency, communication issue mitigation, and potential performance improvements through lessons learned. The FAA and

NEAR Lab coordinated multiple vendors as part of AAtS demonstration partnership teams in the research and development (R&D) domain network environment. Specifically, the external NextGen Prototyping Network (NPN) was utilized to conduct all demonstrations and related experimental research.

The R&D domain provided a means to support multiple demonstrations and tests conducted onboard several aircraft. These aircraft operated under diverse Federal Aviation Regulations (FAR) that included FAR Part 91, 91k, and 135 (Team 1, Table 2) and Part 121 (Team 2, Table 3). Each test / evaluation team included an aircraft; an air-to-ground data link service provider; a data management service provider; an operation control client user; and ERAU that provided planning, development, and implementation of the SWIM environment including R&D National Airspace System (NAS) Services, R&D (NAS) Enterprise Messaging Service (NEMS), and R&D Security Gateway.

Table 2. AAtS Demonstration Team 1 Configuration

	Team 1		
Aircraft	Gulfstream 200	Gulfstream 280	Bombardier Global Express
EFB	iPad	iPad	iPad/Laptop
OS	iOS	iOS	iOS/Window
DLSP	Air-cell	Air cell	Inmarsat
DMS	Honeywell	ERAU/Rockwell Collin	ERAU

Table 3. AAtS Demonstration Team 2 Configuration

	Team 2
Aircraft	Airbus 320
EFB	NavAero
OS	Windows XP
DLSP	GoGo
DMS	ERAU

Findings

The FAA tasked Embry-Riddle Aeronautical University (ERAU) to research security issues and concerns between the DMS and an AAtS-equipped aircraft. The research as summarized in Table 4 has identified eleven (11) potential threat scenarios.

Table 4. AAtS Communications / Cyber-Security Threat Scenarios

Threat Number	Description
TS-1	Improper traffic originating from the EFB
TS-2	Cabin gaining unauthorized access to DLS
TS-3	Cabin user gains unauthorized access to Wireless Access Point
TS-4	Consumption of DLS Bandwidth
TS-5	Unauthorized Network Mapping by Authenticated User
TS-6	External Attacks with IP Address or Hostname
TS-7	Wireless Access Point/Router DoS
TS-8	Rogue access point impersonating Wireless Access Point
TS-9	EFB may make excessive queries, conducting a DoS
TS-10	User in the cabin sniffing flight deck traffic
TS-11	Attack on the Certificate Authority and Rogue Certificates

The ERAU research on security concerns [4] has found that EFB connectivity should use two subnets – one for the cockpit (hardwired) and one for inflight entertainment (IFE) in the cabin (wireless). In addition, the following findings have emerged:

- 1) If a single router is used to connect the EFB subnet with the Cabin WiFi subnet, this attack could easily be performed by a Cabin User, on the Cabin network, causing the same effect on the EFB.
- 2) Malicious user can bypass the captive portal using techniques such as DNS tunneling.
- 3) The whole network can be mapped, existence of measures can be inferred/detected, devices and software versions can be acquired.

- 4) With a successful MITM, the malicious user is in control and in some cases can modify the content of communication on the fly.
- 5) A malicious user can sniff data packets that flow between the EFB and WiFi access point.
- 6) It is a known fact that browsers may not handle certificate revocation lists properly and accept revoked certificates as it was the case in this test.

The goal of the OGC research to harmonize standards within the AAtS space was accomplished through outreach to, and coordination with project activities among multiple standards team members from industry stakeholders. This OGC research [5] found the following:

- 1) There is a missed opportunity to realize the full value of AAtS and the capabilities of services based off of NAS service / SWIM sourcing.
- 2) The value proposition for industry to implement AAtS is lacking.
- 3) Industry faces inherent uncertainty and risk in implementing products for AAtS as defined due to potentially incompatible approaches being taken for air-ground information exchange elsewhere in the world. Global interoperability and therefore a global market is far from a given.
- 4) A harmonized architecture based on AAtS with SC-206, AGIE and OGC standards is achievable and provides a framework for deploying AAtS in a multi domain solution.
- 5) Harmonization across these three standards in the AAtS architecture allows the benefits of the capabilities from each standard to be realized in a consistent implementation.
- 6) The AAtS architecture as defined in IGD v3.0 is too constraining to fully reflect the capabilities and benefits of the harmonized architecture.
- 7) The phase-1 demonstrations report has concluded the following:
 - a) Upon completion of the operational demonstration flights, both FAA and industry can pick up AAtS and

implement it in a production environment

- b) Upon completion of the operational demonstration flights, both FAA and industry should have a clear vision and direction of AAtS.

Demonstration Flights Findings

Utilizing the terrestrial and satellite IP Data links, (see performance standards outlined in Table 5), the quantitative analysis found that the overall, the system performance of the IP Data Link utilized during the demonstrations was adequate for the amount and type of data exchanged. However, additional products will require more bandwidth to reduce latency in message exchanges. Larger data products, like NEXRAD, took longer (between 30 and 80 seconds) to uplink to the aircraft, depending on the size of coverage area requested and the amount and variety of weather phenomena the area contains. Performance enhancements within the DMS and the smaller NEXRAD message sizes also showed improvements in latency during the later demonstrations.

Qualitative analysis of information collected from flight crews found design of the EFB application and interface is crucial. Although AAtS interface design is up to each product developer, the design affects overall ability to decipher and react to information provided. The flightcrews felt real time information provided great validation of pre-flight briefing information. The ability to verify and validate pre-flight weather forecasts based on changes, and communicate with flight operations provide better in-flight planning to the flightcrew. Additionally, flightcrews found nationwide information valuable for long term planning, giving the flight crew the ability to observe and plan with OCC or independently based on long term current and/or forecasted weather and operating conditions, allowing less hectic descent/arrival.

Table 5. Demonstration Flight Terrestrial and Satellite Resources

	Inmarsat	GoGo/Aircell
Applications	<ul style="list-style-type: none"> • Light Internet • Email • VPN Access Ports • Voice Access Ports 	<ul style="list-style-type: none"> • In-Flight Internet • Email • VPN Access Ports • Voice Access Ports
Supported Devices	All WiFi enabled laptops, notebooks, and smartphones for data usage	All WiFi enabled laptops, notebooks, and smartphones for data usage
Uplink Data Rate	432 kbps per modem	3.1 Mbps per modem
Downlink Data Rate	432 kbps per modem	1.8 Mbps per modem
Coverage Area	Near-global	Continental US and portions of Alaska
Technology	Over the INMARSAT I-4 satellites	Over the GoGo Network; proprietary Air-to-Ground network using CDMA towers

Note: Line-of-sight availability is based on the traffic size and coverage size.

Findings from demonstration participants include standardized display information and ground planning software linked to the EFB software so all the calculations and functionalities available to the Dispatcher can be shared with the flight crew. These findings along with the ability to display Traffic Flow Management information could benefit flight operations.

Future

The future of AAtS is to build on a premise that SWIM services can produce a benefit for the operators and FAA thru CATM. As a result, CATM via AAtS will enable improved airspace usage as part of a broader connected aircraft strategy. The belief is that ATM (FAA) and operators will benefit from the increased situational awareness by the flightcrew.

This will enable CATM, and the ability to expeditiously formulate operational solutions working with controllers, flightcrews, and dispatchers.

The AAtS initiative continues to evolve through operational requirements development, cost benefit analyses, lessons learned from the operational demonstrations, pursuit of ongoing technical research, participation in RTCA SC-206 activities, input/feedback from the AWG, and the maturation of IGD. As technology matures, emerging connectivity technologies (e.g., SatCom, air-ground cellular, etc.) will increase to provide greater and faster data throughput.

AAtS can be used as a collaborative ATM pathfinder in the TBO environment. It provides the capabilities, decision-support tools and automation to manage aircraft movement by trajectory. It will enable aircraft to fly negotiated flight paths necessary for full performance based navigation, taking both operator preferences and optimal airspace system performance into consideration. The following subsections describe potential analysis of connected aircraft TT concepts.

Information Products, SWIM Services, and Applications

The success of AAtS will depend on the availability of SWIM products and services. The SWIM infrastructure provides an open, flexible, and secure information management platform for sharing NAS data and enabling increased common situational awareness and improved NAS agility. Coupled with emerging broadband space-communication networks, this infrastructure will support on-demand information exchanges between NAS systems by using SOA architectural design principles. Currently, there are 50 business services that are identified and will be on-ramped to SWIM and consumed by non-NAS users in 2018+. These services can be consumed using Pub/Sub or Request/Reply messaging patterns. These 50 services are all using one of the following formats:

- Aircraft Information Exchange Model (AIXM)
- Weather Information Exchange Model (WXXM)
- Flight Information Exchange Model (FIXM)

Connected Aircraft Business Model and Value Proposition

The FAA understands, based on input received from numerous industry sources, (e.g. RTCA SC-206 members, OGC members, etc.), that OEMs and Operators want AAtS to become viable from a commercial business perspective (see Figure 2). The FAA further understands that if AAtS is to become commercially viable, then it must yield operational benefits. This may occur through operational efficiencies (i.e. cost avoidance) that save time in the air and during ground operations. This will occur principally through reduced block-time requirements to execute a given revenue flight between city pairs (see Figure 3) [6]. Specific benefits will need to be measurable as they relate to system-level accommodation of dynamic stimuli from weather, traffic, and airport ground operations. Savings in block-time requirements for an operator to execute a city pair operation will directly impact an operator's costs, and therefore- their bottom line profitability.



Figure 2. Value Proposition / Business Case for Connected Aircraft



Figure 3. FAA NextGen City Pair Map

The AAtS value proposition offers these additional efficiencies as a result of information made

available to the flightcrew that will facilitate CDM / CATM.

Connected Aircraft Benchmarks

To further advocate aircraft IP connectivity, the AAtS pathfinder team is actively working on a technology transfer (TT) strategy. This strategy is based on closing the business case around three key questions:

- 1) What is the 'materiality threshold' for block-time savings per block-hour of operation?
- 2) What is the expected benefit for operators (e.g. Part 91, 91k, 121, 125, 135, etc.)?
- 3) Under controlled operational benchmark scenarios, what level of benefit (i.e. cost avoidance) will an operator realize in terms of block-time reduction(s) for an average city-pair operation?

Information Coupling to Events and Decisions – Modeling and Simulations

A planning effort is under way to investigate information and decision models for connected aircraft. These models will facilitate simulation runs against numerous operational scenarios illustrating system response both with, and without the benefit of connected aircraft services, CDM, and CATM. Demonstration flights could further validate these simulation data runs, with *in situ* data from actual flight operations. The principal objectives of these *in situ* data will be to establish the heuristic basis for quantitative analyses necessary to forecast operational benefits.

The Challenge: Material Benefits

The technical issues associated with moving large volumes of data and information products over broadband IP data links are well understood. Full motion video, moving maps, and co-registration of geospatially corrected data is commonplace. Broadband access- including broadband access for airborne subscribers is readily available whether on the airport surface, at low altitudes, or cruising cross country.

However, significant uncertainties remain for the community with respect to the overall system response to CDM / CATM, and the quantitative

benefits of connected aircraft that may be available to operators. Future analyses for connected aircraft systems should look to evaluate numerous real-world scenarios, with an eye toward modeling, simulation, and demo-flight validation. These analyses will establish definitive quantitative metrics to support the AAtS stakeholder community, and their strategy for technology transfer into the TBO environment.

References

- [1] Federal Aviation Administration, November 2014, NextGen Implementation Plan, Washington, DC, USA.
- [2] RTCA, March 2013, DO-349 Architecture Recommendations for Aeronautical Information (AI) and Meteorological (MET) Data Link Services, Washington, DC, USA.
- [3] Federal Aviation Administration, March 2015, AAtS Implementation Guidance Document, Version 3.2, Washington, DC, USA.
- [4] Embry Riddle Aeronautical University (ERAU), February 2014, Security/Subnet and Wired vs. Wireless Technical Research Final Report, Version 2.0, Daytona Beach, FL, USA.
- [5] Open Geospatial Consortium, September 2014, Document 14-073, AAtS harmonization Architecture Report, Washington, DC, USA.
- [6] Federal Aviation Administration, October 2014, NextGen City Pairs, Washington, DC, USA. <http://www.faa.gov/nextgen/snapshots/airportpair>

*2015 Integrated Communications Navigation
and Surveillance (ICNS) Conference
April 21-23, 2015*