

Surveillance and Broadcast Services

FAA ADS-B Implementation Status



Federal Aviation Administration



To: ICAO Surveillance Seminar
By: Jim Linney, Program Manager
Date: December, 2010

ADS-B is a Vital Element of the Next Generation Air Transportation System

- **Why Automatic Dependent Surveillance – Broadcast (ADS-B)**
 - Lower cost, more accurate and more frequently updating surveillance infrastructure
 - Higher accuracy and update allows improved tracking and safety capabilities
 - Allows surveillance deployment where previously not possible, e.g. Gulf of Mexico, Alaska, and other areas
 - Enables of air traffic control procedures
 - Enables pilot control procedures and unprecedented pilot situational awareness

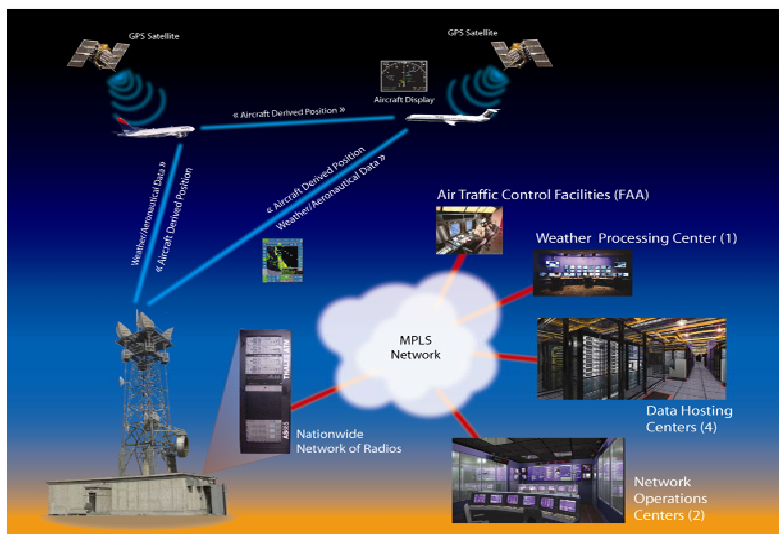


Background: Automatic Dependent Surveillance - Broadcast (ADS-B)

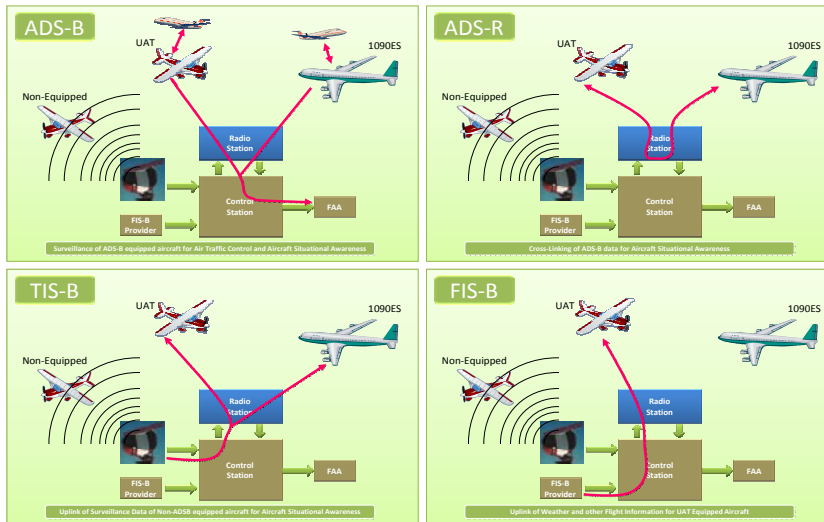
- **Automatic**
 - Periodically transmits information with no pilot or operator input required
- **Dependent**
 - Position and velocity vector are derived from the Global Positioning System (GPS)
- **Surveillance -**
 - A method of determining position of aircraft, vehicles, or other asset
- **Broadcast**
 - Transmitted information available to anyone with the appropriate receiving equipment



ADS-B System Components



ADS-B Service Descriptions



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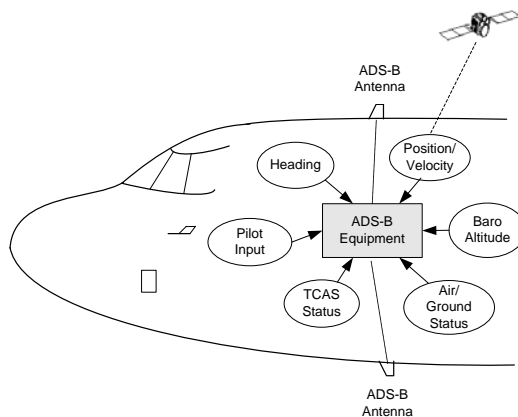


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5

Aircraft System Approach

- Each STC/TC will include the entire ADS-B system



- Multiple interfaces may be approved with a single STC/TC

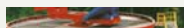
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6

Sensor Characteristics for Fusion

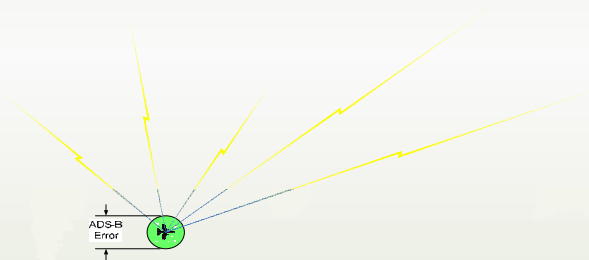


ARSR-40ATCBI-6
- Update Rate: 12 seconds
- Range Accuracy: +/- 180 feet (68%)
- Azimuth Accuracy: +/- 2552 feet (65%) at 250NM
- Range: 250NM

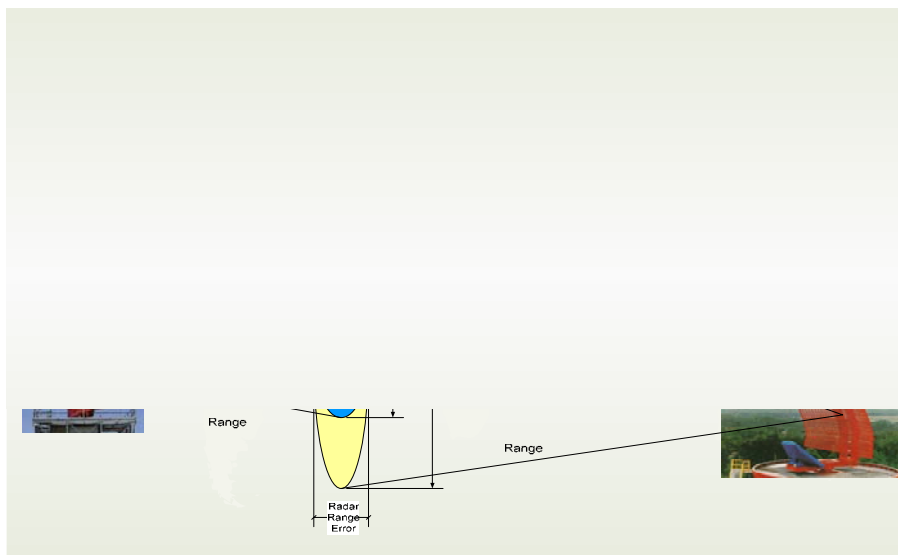
Range
Error



Sensor Characteristics for Fusion



Fusion of Different Sensors



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9

Generic FAA Automation Display of ADS-B



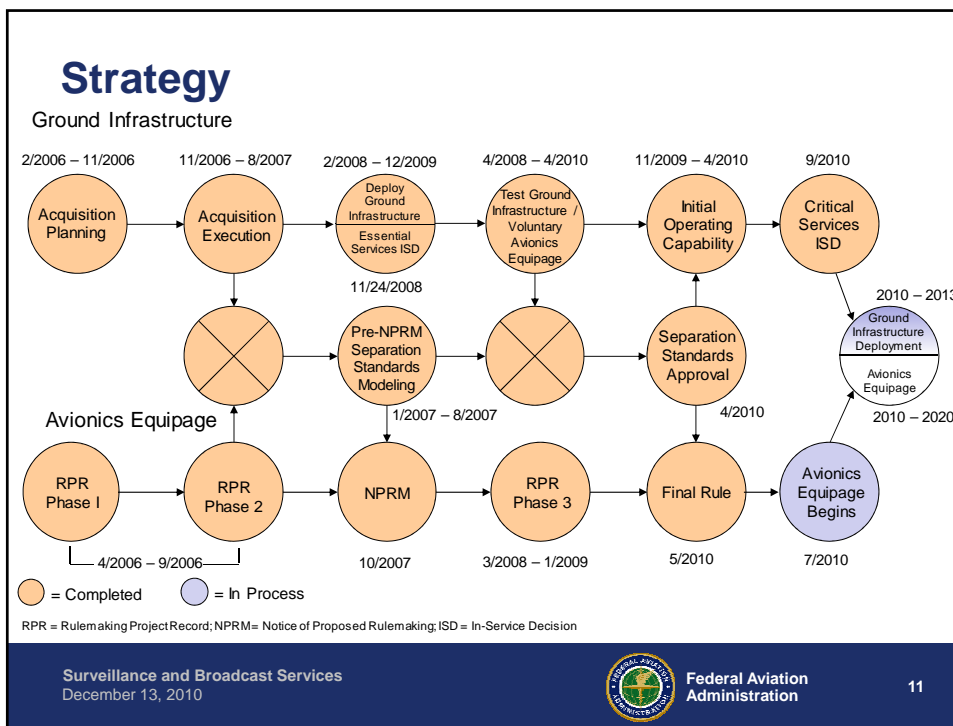
No circle = ADS-B
equipped
Filled Circle = Not
ADS-B equipped
Hollow circle =
Equipped but not
receiving / utilizing
ADS-B for
surveillance

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10



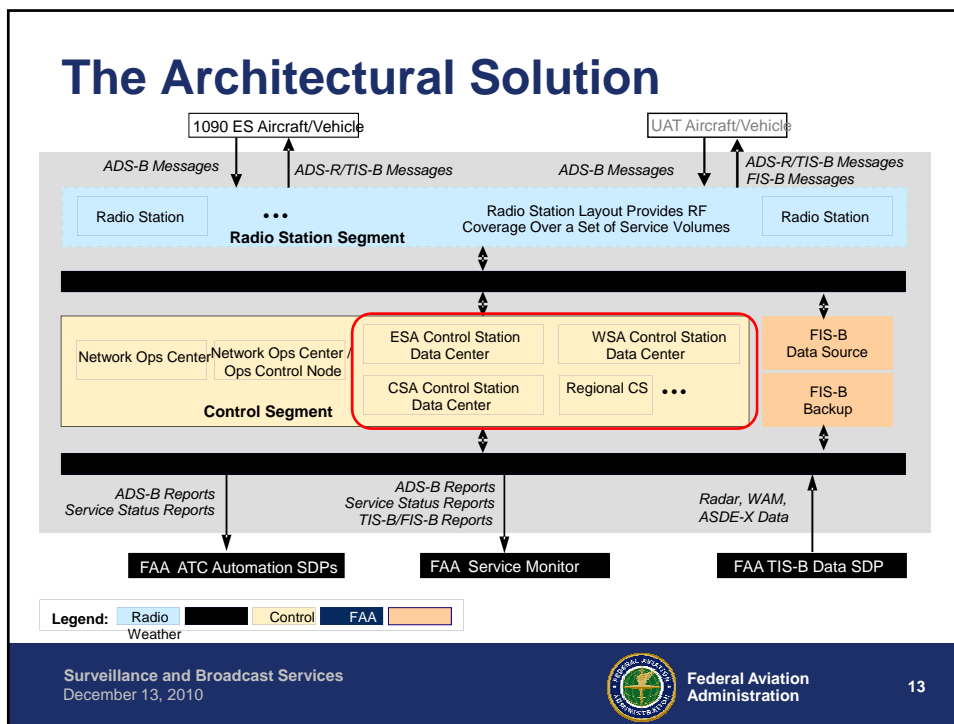
FAA Acquisition Completed ITT Awarded Contract for ADS-B Ground Infrastructure - August 30, 2007

- **Cost effective and exceptional technical solution**
 - Eighteen Year Contract valued at \$1.8B
- **Base contract for Segment One**
 - 3-year period of performance, completed on September 23, 2010
 - Involves design, development and ‘Key Site’ Testing with significant Essential Services deployment
 - Approximately 300 ADS-B ground stations
- **Segment Two began on October 1st**
 - Segment Two implementation will complete national ground infrastructure by year end 2013, ~ 800 sites
 - After deployment, ITT will operate and maintain the ADS-B System through 2025

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12



The FAA's ADS-B Architecture Has Networked Enabled NAS Surveillance

- **The ADS-B Ground Infrastructure architecture routes all NAS surveillance to central control stations**
 - ADS-B data is brought to control stations for target validation, duplicate removal, geographic filtering
 - Radar and surface surveillance data is brought to control stations for creation of the Traffic Information Service-Broadcast (TIS-B) service
- **ADS-B data is put on the network as multicast protocol groups – any NAS facility or trusted user connected to the network requiring a data set need only subscribe to the multicast protocol group for the desired data set – great ease in distributing data**
- **Radar and surface surveillance data can be treated in the same way**

Taking Commercial Advantage of Air Traffic Surveillance Data

- **ITT has developed a Value Added Services Infrastructure to enable commercialization**
- **Network architecture allows commercialization of data - fully isolated from the operational network**
- **Provides:**
 - Streaming of data - geographically or otherwise filtered / real-time or delayed
 - Archiving and retrieval of data for historical analysis
 - Web based tool for data visualization
 - Fleet tracking
 - Facilities for hosting value added applications, e.g. over-flight/airport billing

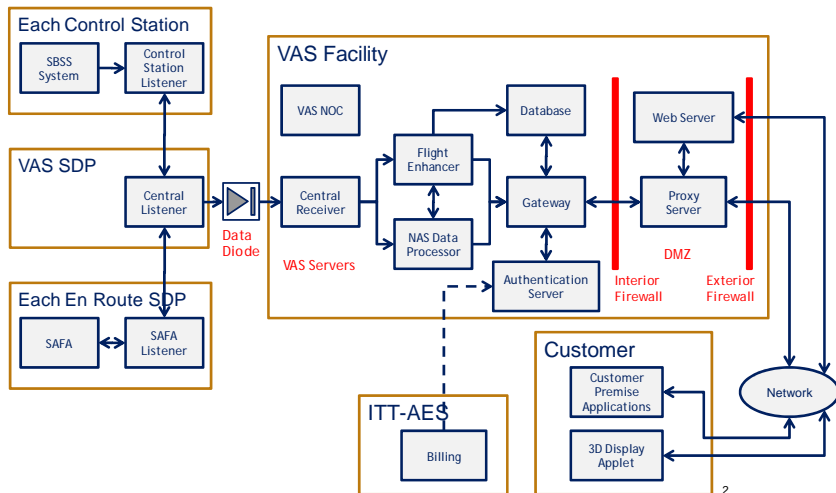


A Data Utility Has Been Created for external users

- **Fully isolated from the operational network**
- **Provides:**
 - Streaming of data - geographically or otherwise filtered/ real-time or delayed
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Value Added Services Architecture



Critical Services Service Volume Roll-Out Key Sites



| | | |
|-----------------------|----------------|---|
| Louisville | 10/2009 | ✓ |
| - CARTS | | |
| Gulf of Mexico | 12/2009 | ✓ |
| - HOST/ERAM | | |
| Philadelphia | 03/2010 | ✓ |
| - STARS | | |
| Juneau | 04/2010 | ✓ |
| - MEARTS | | |
| ISD | 09/2010 | ✓ |



Rulemaking Overview

- **On May 27, 2010, the FAA published the Final Rule for ADS-B Out equipage**
 - Mandates performance requirements for ADS-B avionics that will be required to fly in certain airspace
 - ADS-B Out transmits location to ADS-B ground stations and to other aircraft equipped to receive ADS-B broadcasts. The rule does not preclude non-GPS position sources
 - This rule does not mandate ADS-B In
 - A new Aviation Rulemaking Committee (ARC) was chartered in June 2010 to address ADS-B In strategy
- **Establishes 2020 as the date by which all aircraft flying in the designated airspace must be equipped with ADS-B Out**
 - Gives aircraft owners time to determine the most cost-effective solution for the mix of aircraft in their fleets.
 - FAA expects that most air-transport category aircraft will be equipped by 2015 (some stragglers waiting until the 2020 deadline)

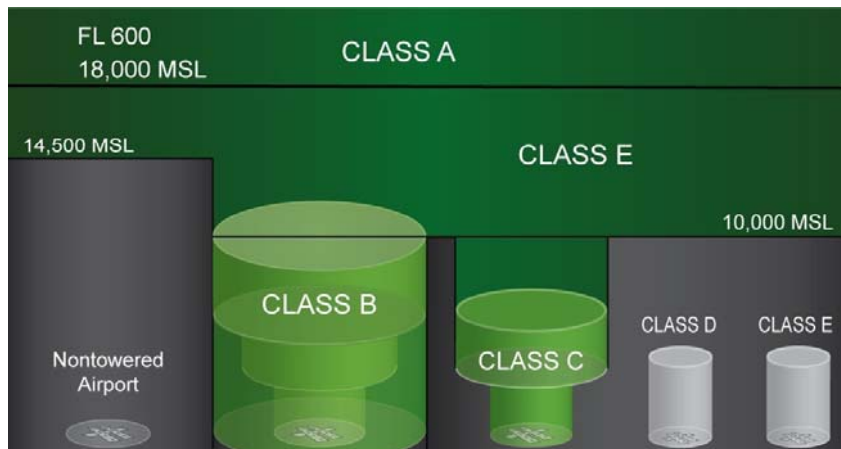


Rule Airspace

- **ADS-B Performance is required in the following airspace:**
 - Class A, B, and C airspace
 - Class E airspace areas at or above 10,000 feet MSL over the 48 contiguous United States and the District of Columbia, excluding the airspace at and below 2,500 feet above the surface
 - Airspace within 30 nautical miles (NM) of certain identified airports that are among the nation's busiest (based on annual passenger enplanements, annual airport operations count, and operational complexity) from the surface up to 10,000 feet MSL. These airports are listed in appendix D to part 91.
 - Above the ceiling and within the lateral boundaries of a Class B or Class C airspace area up to 10,000 feet mean sea level (MSL)
 - Class E airspace over the Gulf of Mexico at and above 3,000 feet MSL within 12 NM of the coastline of the United States



Required ADS-B Airspace (In Green)



Note: 1090MHz ES link is required above FL180



ADS-B Guidance Documents Completed

- **The Technical Standard Orders (TSOs) for ADS-B avionics were approved in December 2009. The final rule requires:**
 - Equipment designed for 1090ES (1090 MHz) must meet TSO-C166b or later versions of this order; and
 - Equipment designed for UAT (978 MHz) must meet TSO-C154c or later versions of this order
- **Advisory Circulars**
 - AC 20-165 provides installation guidance for ADS-B Out systems
 - DRAFT AC 90-ADSB
 - provides guidance and information on ADS-B Out in accordance with 14 CFR 91.225 and 91.227. No OPS approval is required for ADS-B "Out".



ADS-B Services and Applications

| |
|--|
| Services: |
| ATC Separation Services (En Route, Terminal, Surface): ADS-B and ADS-R |
| Cockpit Services: Traffic / Flight Information Broadcast Services (TIS-B / FIS-B) |
| Situational Awareness Applications: |
| Enhanced Visual Acquisition |
| Enhanced Visual Approaches (1) |
| Final Approach and Runway Occupancy Awareness |
| Airport Surface Situational Awareness |
| Traffic Situational Awareness with Alerts (2) |
| Advanced Applications: |
| In Trail Procedures (ITP) |
| Interval Management (IM) |
| Surface Indications and Alerts (SURF-IA) |

- (1) Merging and Spacing and Cockpit Display of Traffic Information (CDTI) Assisted Visual Separation (CAVS) are a part of the Enhanced Visual Approaches Application
- (2) Also known as Airborne Situational Awareness and Alerting (ATSA AIRB) or Conflict Detection (CD)



SBS External Agreements: Model for Collaboration



ANPC MOA
August 2010



SSA MOA
December 2009



AOPA MOA
October 2009



Auburn University MOA
September 2009



United MOA
April 2009



U.S. Airways/ACSS MOA
January 2009



NetJets MOU
December 2008



Honeywell
October 2008



Aviation Communication
and Surveillance Systems
October 2008



Alaskan Aviation Community
& State Representative MOA
February 2007



UPS MOA
November 2006



Colorado DOT
September 2006



HAI & Gulf of Mexico
Helicopter/Platform Owners MOA
May 2006



ADS-B Services and Applications

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ADS-B In Aviation Rulemaking Committee

Member Affiliation



Recommendations:

- ADS-B In Research
- ADS-B In Business Benefits
- ADS-B In Applications Investments

Tasks:

- Provide Committee position for continued work on 3 ADS-B-In Application standards development projects -> by Oct 2010
- Provide Final ARC ADS-B-In Strategy Recommendations -> by Sep 2011
- Delivery of products from follow-up activities -> by Jun 2012

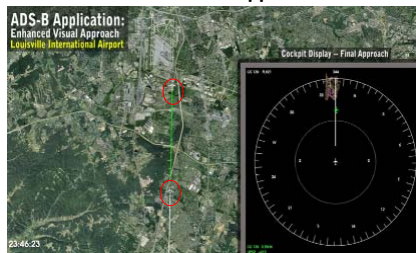


Essential Services - Airborne Applications

Enhanced Visual Acquisition



Enhanced Visual Approach



Final Approach and Runway Occupancy



Airport Surface Situational Awareness



Airborne Applications

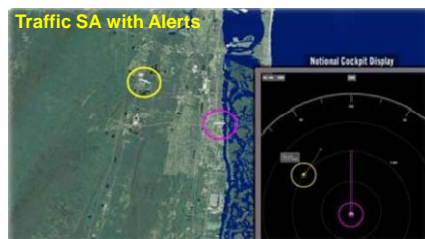
Situational Awareness



Spacing



Indications and Alerts



Indications and Alerts



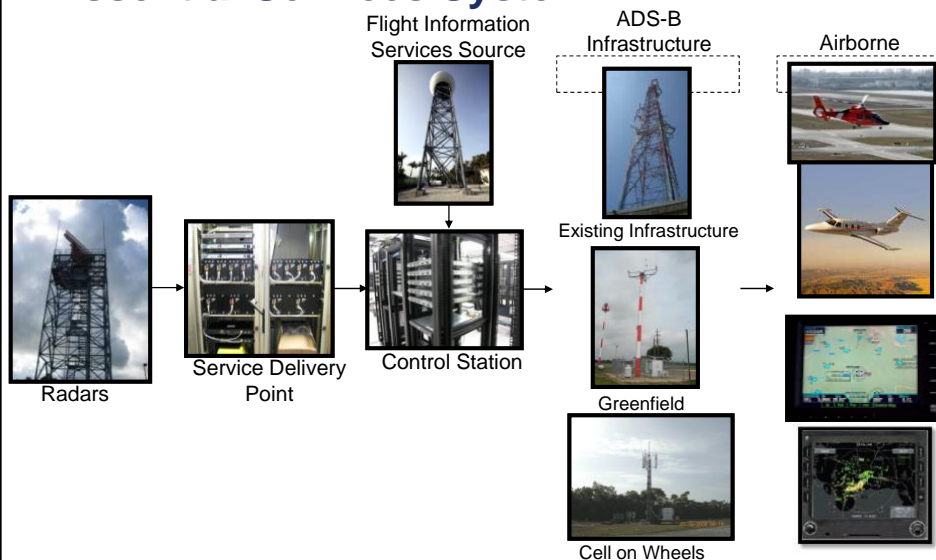
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Essential Services System



New Free Broadcast Services Available

Cockpit Services



Traffic Information Services – Broadcast (TIS-B) is a service which provides ADS-B equipped aircraft with position reports from secondary surveillance radar on non-ADS-B equipped aircraft.



Flight Information Services – Broadcast (FIS-B) is a service which transmits graphical National Weather Service products, pilot reports, and special use airspace.



| Free Products | Update Interval | Transmission Interval |
|--------------------------------|--|-----------------------|
| AIRMET | As Available | 5 minutes |
| Convective SIGMET | As Available then at 15 minute intervals for 1 hour | 5 minutes |
| METAR / SPECI | 1 minute (where available) as available otherwise | 5 minutes |
| NEXRAD Reflectivity (CONUS) | ~ 5 minutes (10 minutes for clear air mode) | 15 minutes |
| NEXRAD Reflectivity (Regional) | ~ 5 minutes (10 minutes for clear air mode) | 2.5 minutes |
| NOTAMS - D/FDC | As Available | 10 minutes |
| PIREP | As Available | 10 minutes |
| SIGMET | As Available, then at 15 minute intervals for 1 hour | 5 minutes |
| SUA Status | As Available | 10 minutes |
| TAF / AMEND | 8 hours | 10 minutes |
| Temperature Aloft | 12 hours | 10 minutes |
| Winds Aloft | 12 hours | 10 minutes |

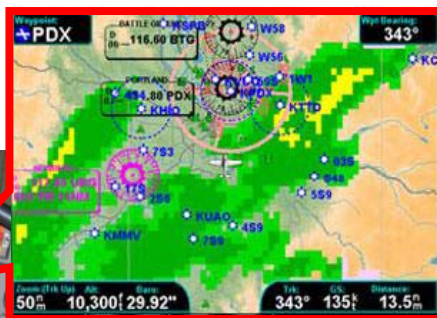


Essential Services: Traffic Information Service - Broadcast

TIS-B is a service which provides ADS-B equipped aircraft with position reports from secondary surveillance radar on non-ADS-B equipped aircraft.



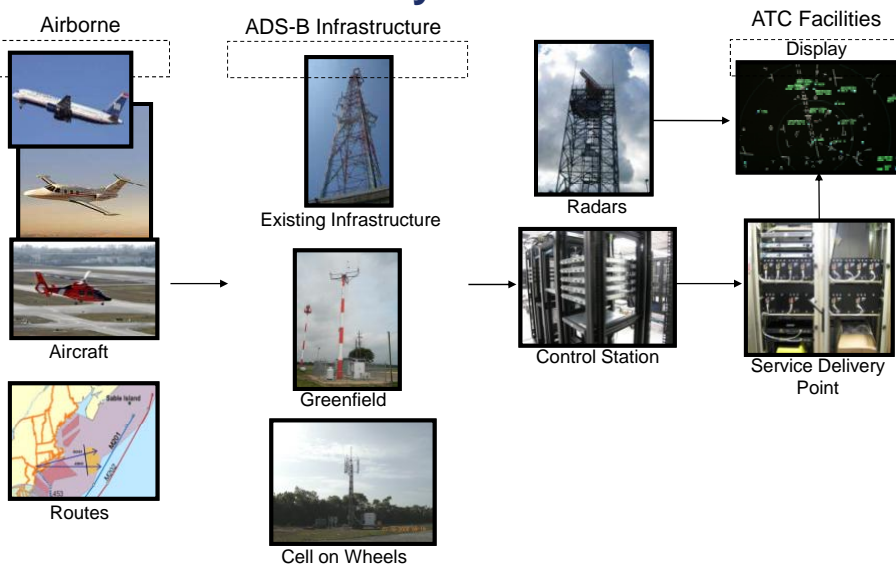
Essential Services: Flight Information Service – Broadcast



FIS-B transmits graphical National Weather Service products, pilot reports, and special use airspace.



Critical Services System



Typical ADS-B Site



“Green Field”



ADS-B Off Shore



Oil Platform Installation (ADS-B and Automated Weather)



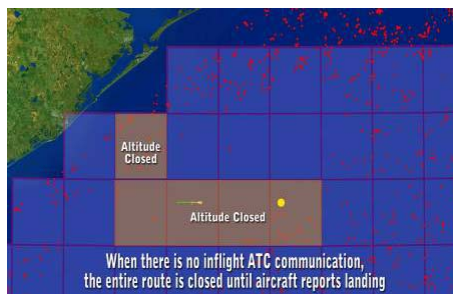
ADS-B Radios



Transportable Installation



Gulf of Mexico: Low Altitude

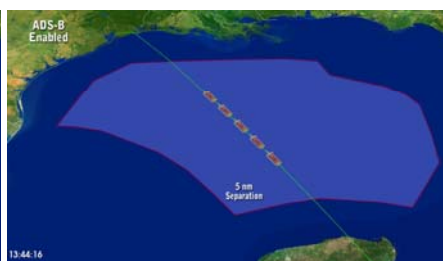
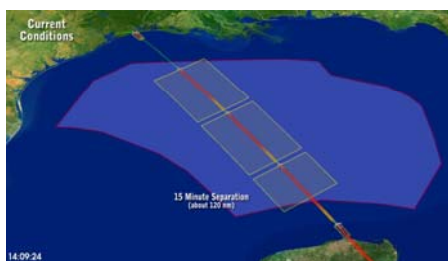


• **Benefits**

- Increased ability to fly part 135 operations
- Fewer encounters with hazardous weather
- Improved search and rescue



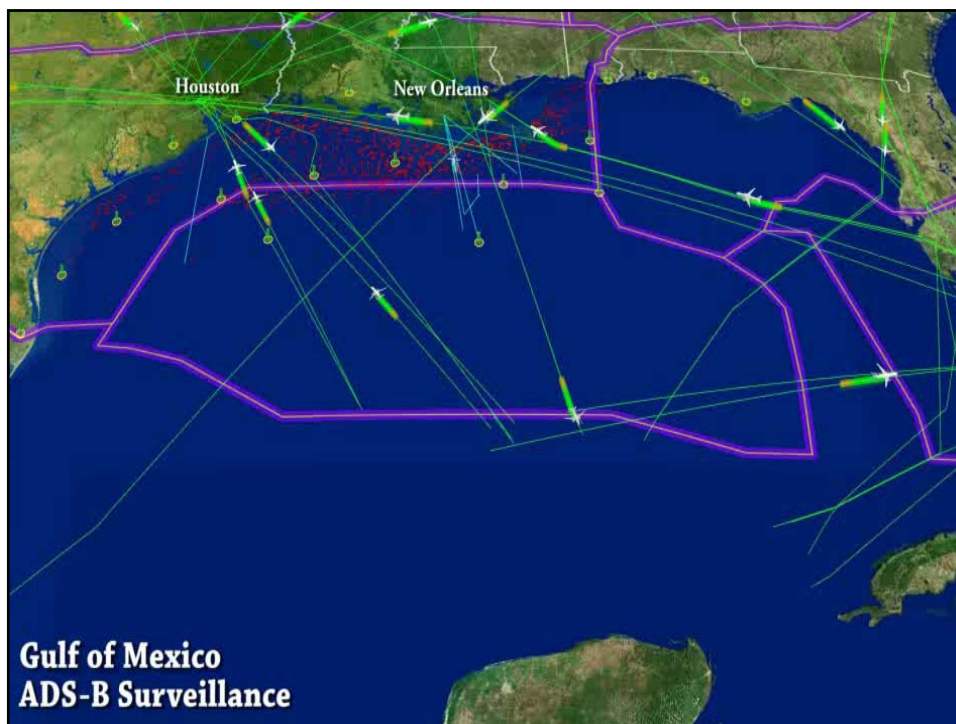
Gulf of Mexico: High Altitude



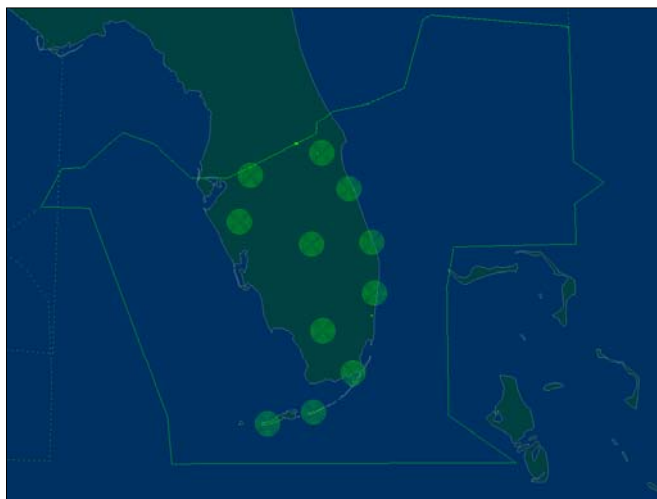
• **Benefits**

- More efficient separation, increased capacity
- Increase availability of more fuel efficient altitudes and routings
- Accommodate weather deviations without impacting adjacent routes
- Eliminate lengthy delays in issuing clearances through a third party





An Architecture Delivering Network Enabled Surveillance – Miami FIR

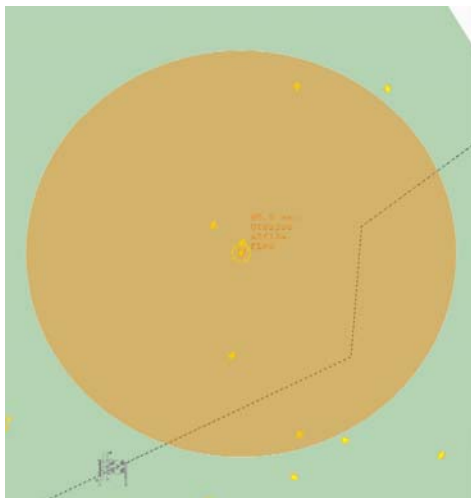


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Delivering Terminal and En Route Surveillance Performance – Orlando



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43

Delivering Airport Surface Surveillance Performance – Louisville



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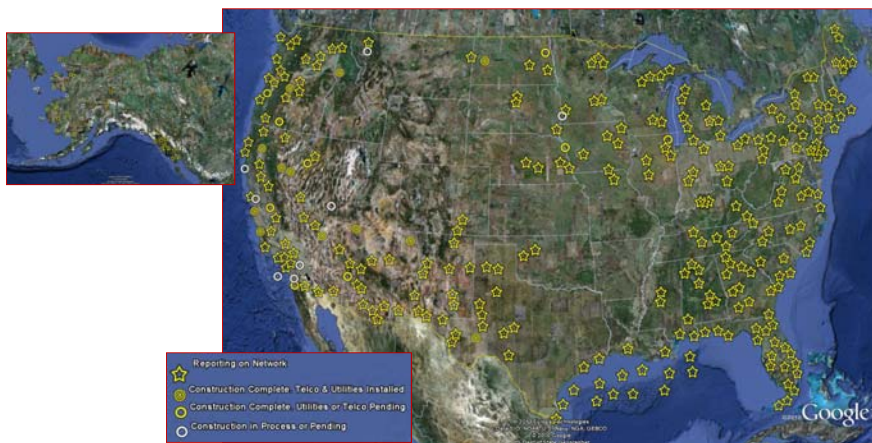


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44

Implementation Status: Oct 22, 2010

- 320 radio sites planned this year (4 western Alaska sites may miss the build season and need to wait until Spring)
- 304 radio sites constructed (279 in CONUS; 25 in AK)
- 275 radio sites reporting on the network (258 in CONUS; 17 in AK)
- 113 IOC radio sites (ZMA, Gulf, SDF, PHL, JNU, ZBW, ZJX, and ZOB)



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45

Benefits Summary

AIR TRANSPORT

- Reduction & more efficient maneuvers in response to URET
- More efficient metering based on improved TMA accuracy
- Increased safety on the surface by controllers
- More efficient spacing on approach in VMC
- Continuation of Visual Approaches in marginal conditions
- Increased ability to allow continuous descent approaches
- Increased safety on the surface by pilots
- High altitude - Increased capacity in Gulf of Mexico
- High altitude - optimal routing in Gulf of Mexico
- Increased IFR capacity (Alaska and Gulf of Mexico)

GENERAL AVIATION

- Fewer aircraft to aircraft conflicts
- Fewer encounters with hazardous weather
- More efficient routes in adverse weather
- Reduction in user costs to obtain weather info
- Fewer aircraft to terrain conflicts
- Fewer aviation accidents in Alaska
- Access to lower altitude routes in Alaska
- Improved search and rescue services in Alaska
- Increase access to remote villages in Alaska
- Increased medevac access to remote villages in Alaska

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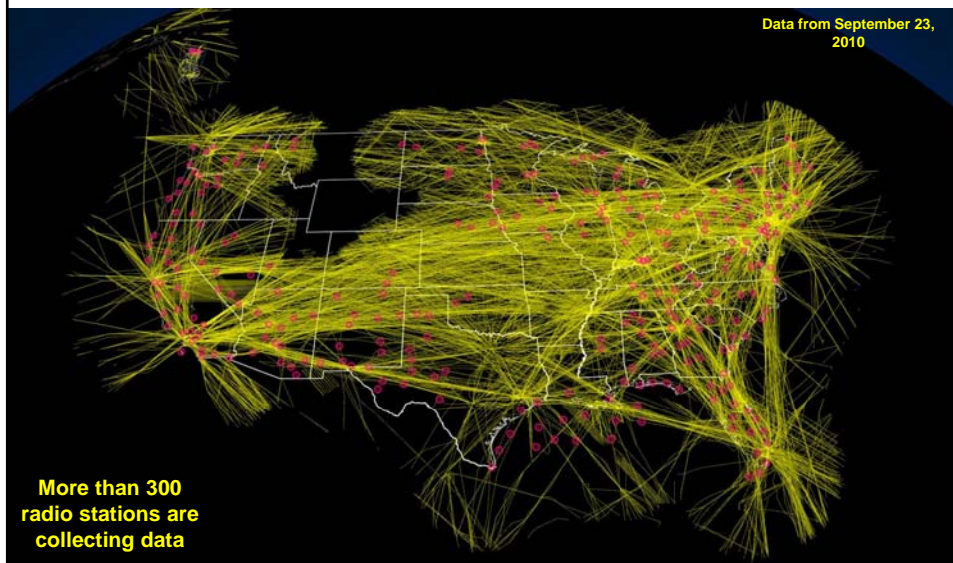
46

Summary

- **FAA suggests the following:**
 - ADS-B ground infrastructure is complex - systems integration and integrity is critical to achieve approval for safe separation
 - Assuming older standards of ADS-B for 5 Mile separation in non-radar airspace will limit benefits
 - Benefits possible with ADS-B in 3 Mile terminal operations, airport surface operations, and the numerous - highly beneficial ADS-B In applications which require high performance avionics and high integrity ground infrastructure (FAA has shared data through the Requirements Focus Groups and in RTCA and EUROCAE)
 - Use of FAA Final Rule and standards (DO-260B) which provide maximum benefits possible for applications (ADS-B In) as known today through via FAA safety analysis
- **FAA is:**
 - Committed to maximizing interoperability between air navigation service providers
 - Willing to enter into agreements for studies to assist (operational, scientific and economic)
 - On schedule and on budget for completing radios by 2013
 - Operating Essential Services which provide high value to General Aviation users
 - Operating Critical Services in 4 locations with more planned in 2011
 - Working with industry and stakeholders on ADS-B In applications to benefit early users



Coverage from Radio Stations





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(W) 202-385-6284 - HQ support (schedule, link to Program Office & data management)

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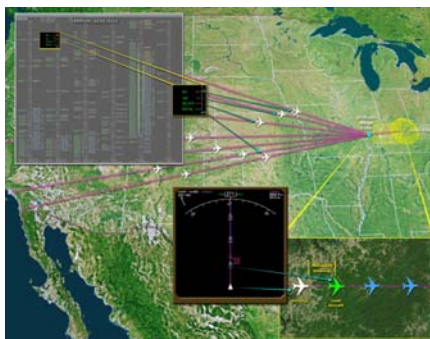
Interval Management

Purpose: Produce operational benefits through precise management of intervals between aircraft whose trajectories are common or merging

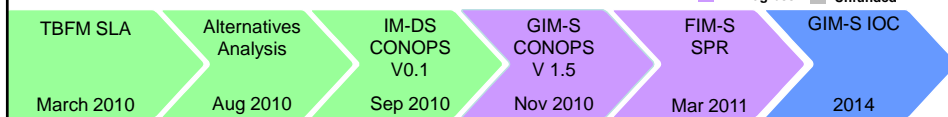
Goal: Create an operational environment that maximizes airspace throughput while enabling aircraft to minimize fuel burn and environmental impacts.

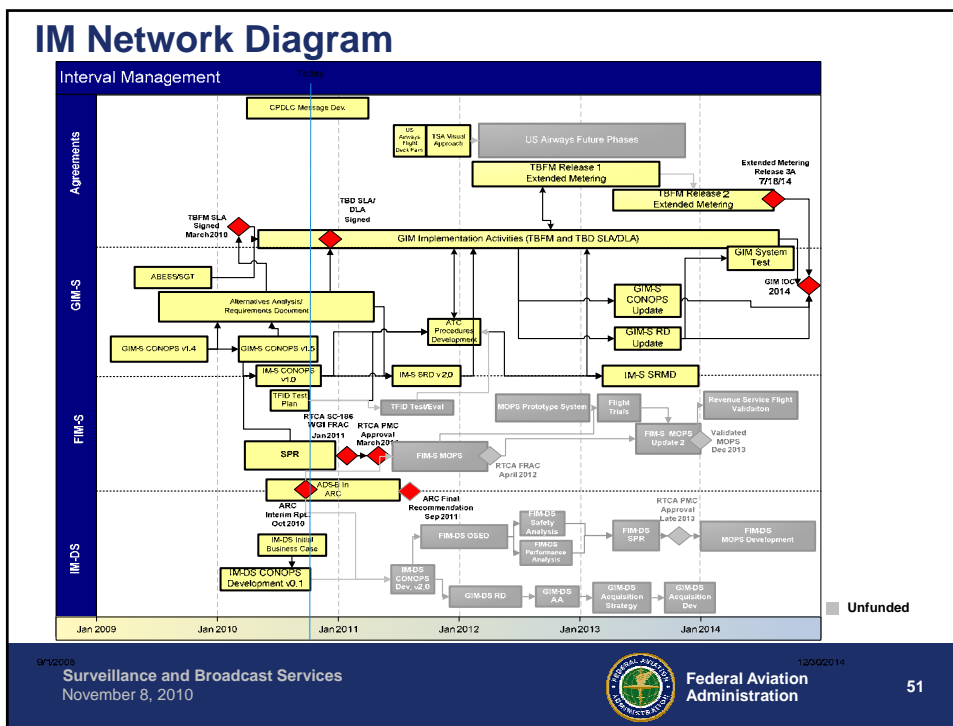
Objectives:

- Ensure NAS implementation of GIM-S functionality to begin benefits accrual (GIM-S IOC)
- Produce a Validated FIM-S MOPS
- Assist in certification of avionics based on functional approach (FIM-S)
- Assist one airline obtain Ops approval with benefits accrual, based on functional approach
- Develop IM-DS CONOPS



Partners: US Airways, ACSS, UPS





Ground-Based Interval Management - Spacing

Purpose: Minimize vectoring during arrival sequence and maximize the opportunities for OPDs and FIM-S operations

Goal: Achieve optimal spacing intervals between arriving aircraft using an ATC based spacing/metering tool

Objective: Ensure NAS implementation of GIM-S functionality to begin benefits accrual (GIM-S IOC)

Partners: TBFM, ERAM

■ Complete ■ Not Yet Started
■ In Progress ■ Unfunded

| | | | | | |
|------------------------------------|------------------------|-----------------------------------|--------------------------------|---|-------------------|
| Advanced M&S CONOPS August 2009 | TBFM SLA March 2010 | Alternatives Analysis Aug 2010 | GIM-S CONOPS V 1.5 Nov 2010 | GIM-S Requirements Document Mar 2011 | GIM-S IOC 2014 |
|------------------------------------|------------------------|-----------------------------------|--------------------------------|---|-------------------|

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November 8, 2010

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52

Flight Deck Based Interval Management – Spacing (FIM-S)

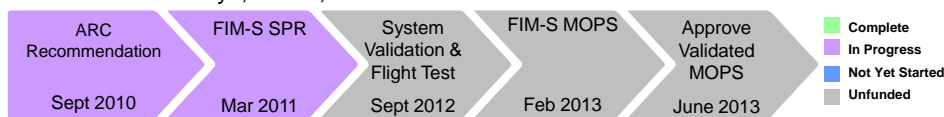
Purpose: Reduce fuel burn, noise and omissions, while maintaining high throughput and efficient flight operations throughout the NAS

Goals: Develop and validate flight deck technology to enable FIM-S Operations

Objective: Produce a Validated FIM-S MOPS
 Assist in certification of avionics
 Assist one airline in obtaining Operational approval with benefits accrual



Partners - US Airways, ACSS, UPS



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53

Interval Management – Delegated Separation (IM-DS)

Purpose: Create an operational environment that reduces controller workload, maximizes airspace throughput and enables aircraft to minimize fuel burn and environmental impacts.

Goal: Develop flight deck and ATC based technologies to allow IM Operations that delegate separation responsibility from an ATC designated aircraft to the flight crew.

Objectives: Develop IM-DS CONOPS
 Increase airspace throughput by managing interval distance at the separation standard



Partners: US Airways, ACSS, UPS



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54

ITT can Perform Full Operations and Maintenance Monitoring

Network Operations Center



- 24 hours-7days a week remote maintenance monitoring

Integration and Operational Control Labs



- End-to-end upgrade testing and trouble-shooting

ITT Conducts System Integration and Test Activities to Meet Development and Customer Needs

