Federal Aviation Administration

FAA ADS-B Overview

Presented by:
Federal Aviation Administration

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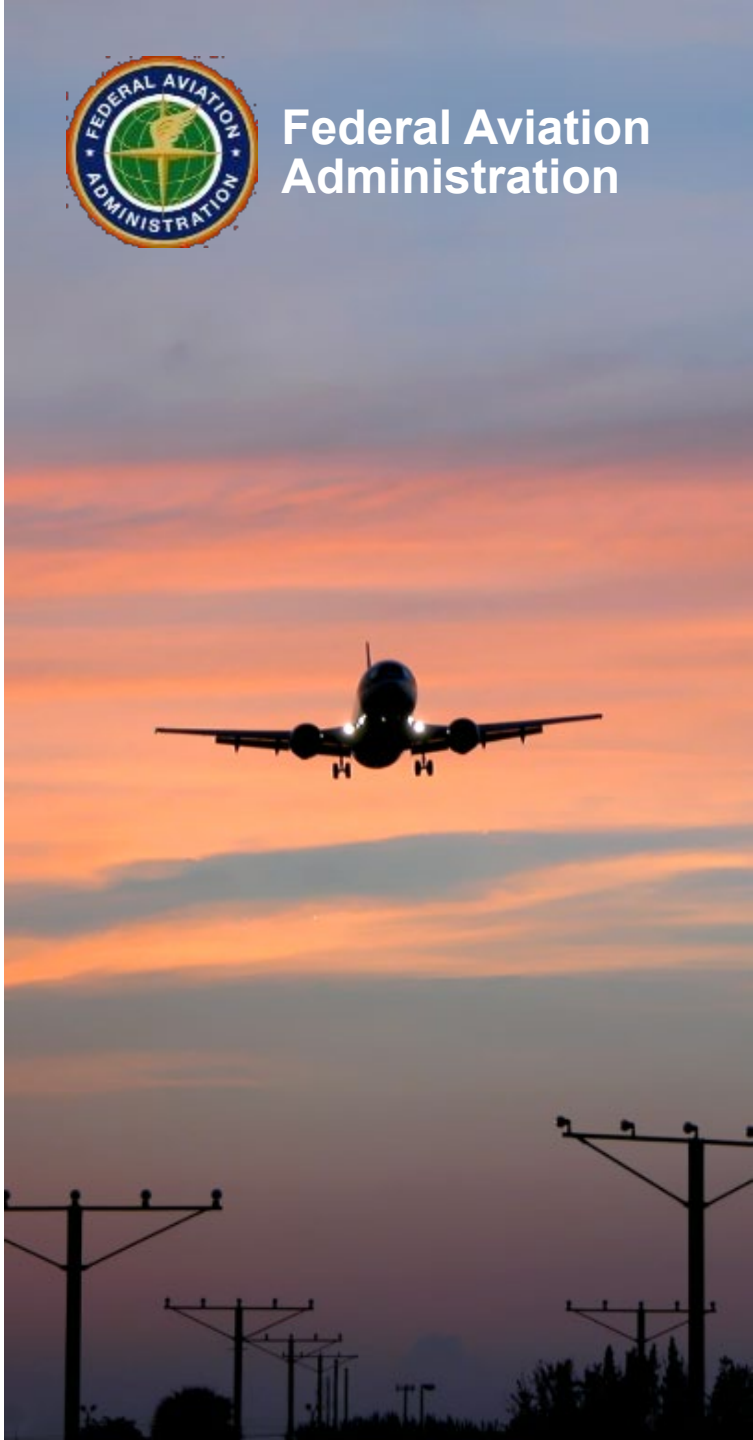


Outline

- U.S. ADS-B Mandate
- Ground Deployment Status
- Operational use of ADS-B in U.S. airspace
- Benefits of ADS-B

U.S. ADS-B Out Mandate

- Published May 27, 2010; compliance date January 1, 2020
- Identifies certain **airspace** where ADS-B Out will be required and the **performance** requirements for ADS-B avionics
  - 14 CFR 91.225 specifies Automatic Dependent Surveillance-Broadcast (ADS-B) Out equipment and use including applicable airspace
  - 14 CFR 91.227 specifies Automatic Dependent Surveillance-Broadcast (ADS-B) Out equipment performance requirements
- Applies to **all aircraft** (foreign and domestic)
- Exceptions - The rule does not apply to aircraft
  - Not originally certificated with an electrical system, or
  - Not subsequently certified with such a system installed, including balloons and gliders

Understanding U.S. ADS-B Mandate Airspace

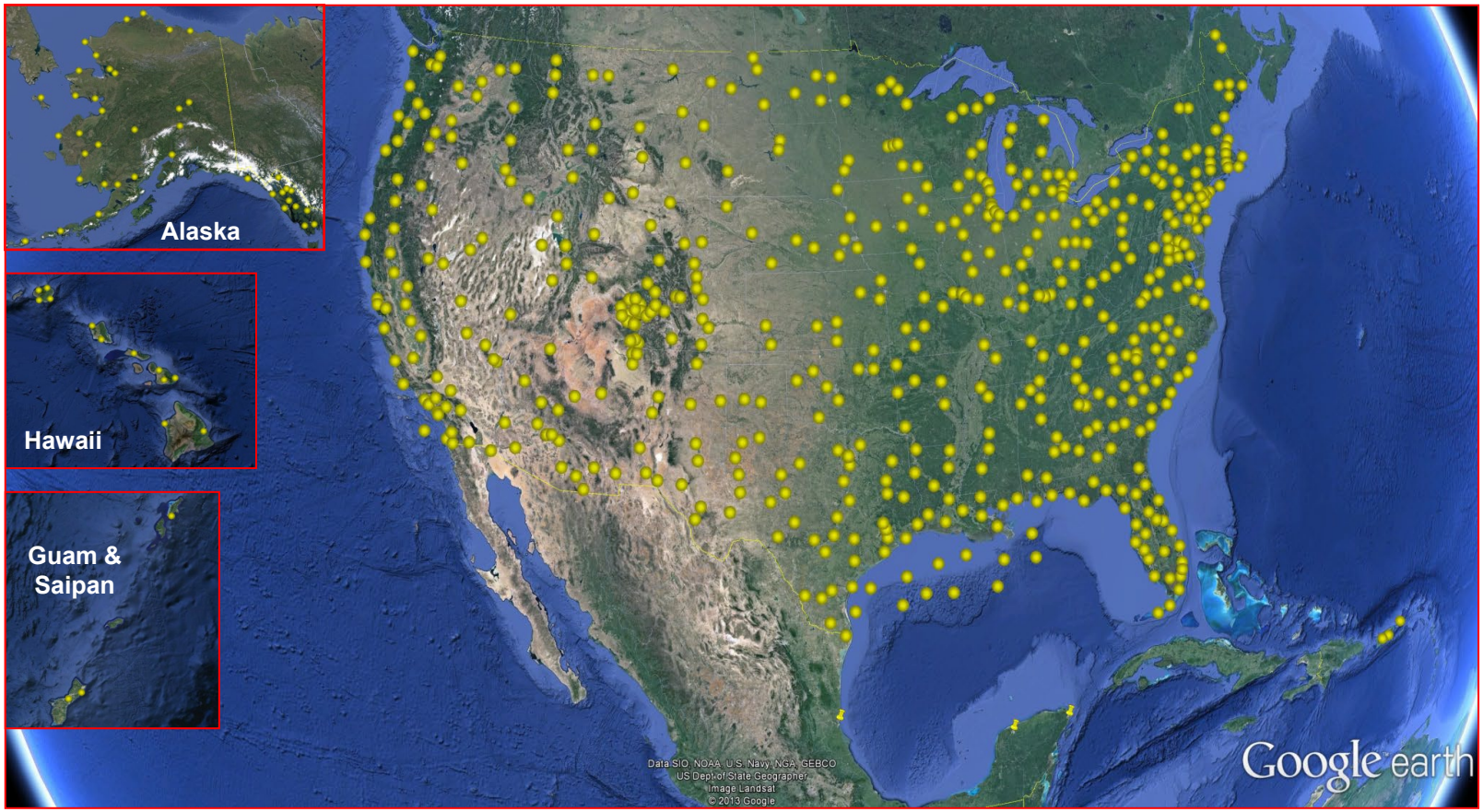
Visit: https://www.faa.gov/air_traffic/technology/equipadsb

Rulemaking, TSO, and Advisory Circular Update

- **FAA is in the final stages of updating the existing ADS-B regulations and associated transponder regulations**
  - Inclusion of TSO-C166c and TSO-C154d to 14 CFR 91.225 and 91.227
  - Amendments to Part 43 Appendix F and 14 CFR 91.215 to remove requirement to reply to intermode (Long P4)
  - Out for public comment as Direct to Final with due date of 16-Nov-2023.
    - Refer to: https://www.federalregister.gov/documents/2023/10/17/2023-22710/inclusion-of-additional-automatic-dependent-surveillance-broadcast-ads-b-out-technical-standard)
- **TSO publications:**
  - TSO-C112f: ATCRBS/Mode S Airborne Equipment (i.e., Mode S Transponder) published on March 10, 2023
  - TSO-C166c: Extended Squitter ADS-B published on March 10, 2023
  - TSO-C154d: Universal Access Transceiver (UAT) operating on 978 MHz published March 10, 2023
  - TSO-C195c: Avionics supporting ADS-B In published on June 15, 2023
- **Regulatory documents can be found at https://drs.faa.gov/browse**

Ground Deployment Status

FAA Surveillance and Broadcast Services Implementation Status



https://www.faa.gov/air_traffic/technology/equipadsb/research/airspace

Operational Use of ADS-B in U.S. Airspace

Fusion Considerations in the FAA

- The FAA is utilizing fusion technologies with ADS-B to take advantage of potential benefits related to fusion:
  - Synchronization of track updates on an operational display regardless of surveillance source update rates for improved separation awareness.
  - Improvement to target position and velocity accuracy leading to reduced separation.
  - Provides increased reliability and redundancy for area with multiple sensor coverage.
  - Simpler integration of new surveillance sources, such as multilateration, into automation or other tracking processes.
  - Provides opportunities for computer-human interface improvements and decreased clutter on the display which will also improve situational awareness.
  - Eliminates significant jumps in target position as compared with mosaic displays.
  - Improves Safety Function performance for Minimum Safe Altitude Warning (MSAW), conflict alert, etc.

Benefits of ADS-B

Benefits of ADS-B

- The ADS-B program's **strategy** has always been to deploy an infrastructure that can be leveraged for **future operational benefits.** The ADS-B mandate set the FAA on a path to achieve success in:
  - **Reducing Separation: Enable 3nm separation standards in en route airspace where it was not available before.**
  - **Radar Divestiture: Overlapping ADS-B and legacy radar coverage provides the FAA with the opportunity to right-size our surveillance infrastructure across the NAS.**
  - **Surface Surveillance: Continue to leverage ADS-B infrastructure on the airport surface to enhance situational awareness for ATC, pilots, and vehicle operators.**
  - **ADS-B In Applications: ADS-B In brings the opportunity to implement various applications that transform the ability of controllers and pilots to increase efficiency of spacing operations in the NAS.**
  - **Collision Avoidance: The next generation of collision avoidance capabilities, ACAS-X, is leveraging ADS-B technologies to enhance aviation safety and accommodate new entrants into the NAS.**

Space-Based ADS-B (SBA) Background

- **Since 2017, the FAA has conducted an extensive and rigorous evaluation under the agency's mandated Acquisition Management System (AMS) process of the existing satellite-based ADS-B (SBA) implementation.**

- **The evaluation included analysis of SBA to enable reduction in oceanic separation, as well as use in other domains and non-separation applications.**

- **Based on this review, the FAA identified several limitations with the existing SBA implementation.**

SBA Determination

- **After careful consideration, the FAA determined not to recommend moving forward with the currently available SBA implementation at this time due to:**
  - The high costs for the marginal benefits provided for use in U.S.-managed ICAO airspace.
  - The limitations listed on the previous slide.

- **The FAA is re-focusing its resources on industry engagement around this technology to reassess market capabilities and determine if other implementation approaches are viable for future investment considerations.**

- **The FAA provided the final SBA report at the latest ICAO Aeronautical Surveillance Working Group meeting in Montreal.**

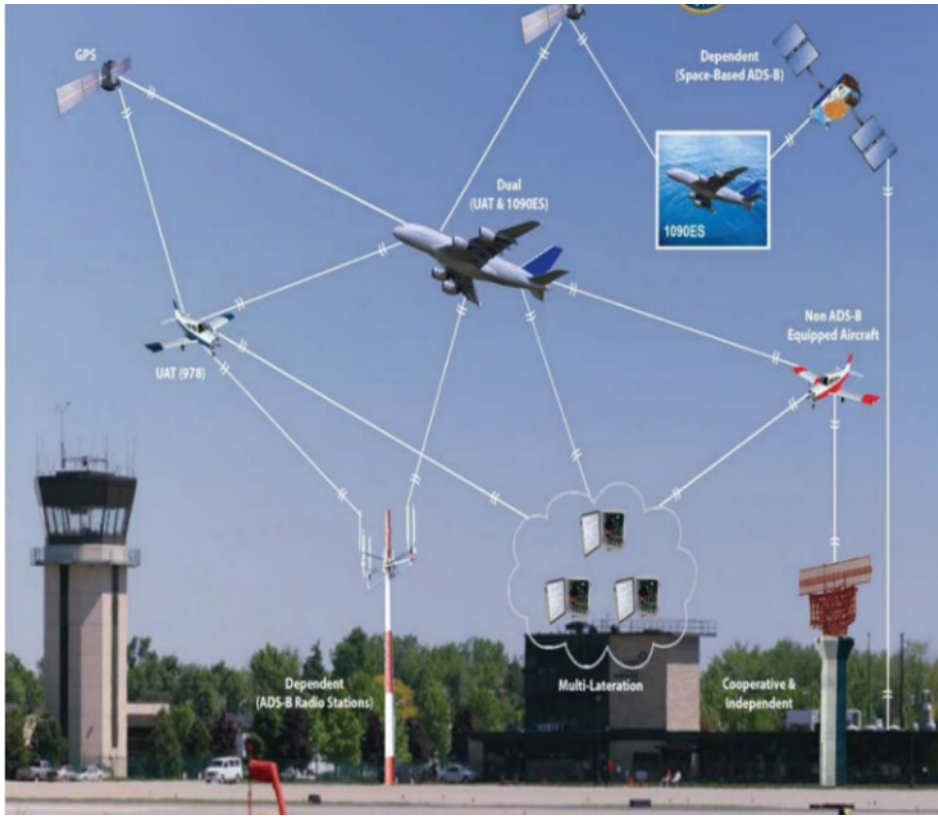
FAA Industry Engagement on SBA

- **In April 2023, the FAA issued a market survey to identify potential options for cost-efficient and technologically acceptable SBA deployment in the future.**
- **FAA received several responses from interested vendors.**
- **Vendor responses include information on technical capability, readiness, funding, and the potential for partnership with FAA per requirements of the market survey.**
- **The FAA is currently reviewing vendor responses to the market survey.**
  - After the review, the FAA will determine next steps.

Radar Divestiture | History

The FAA has fully integrated Automatic Dependent Surveillance-Broadcast (ADS-B) services into the National Airspace System (NAS).

- ADS-B and Fusion is fully **operational** in the FAA National Airspace System (NAS)
- ADS-B is now the FAA's **preferred** air traffic surveillance source.
- As of November 2022, **173,000+** aircraft in the U.S. are equipped with ADS-B Out.
- ADS-B Mandate in effect in rule airspace
- Radars are still required for Non-ADSB, backup and Weather Data
- Radar Divestiture Project funded in 2020.
- 32 Candidate Terminal Radars in scope



Radar Divestiture | Program Overview

Partnership

- Federal Aviation Administration (FAA)
- National Air Traffic Controllers Association (NATCA)
- Professional Aviation Safety Specialists (PASS)
- Departments of Defense (DoD) and Homeland Security (DHS)

Mission

Capitalize on the benefits of new surveillance technologies by strategically reshaping our radar infrastructure to gain efficiencies and optimize services for ATC operations today and into the future.

Benefits

- Significant cost avoidance through 2035 associated with operating, maintaining, and sustaining radar surveillance systems.
- Operational equipment from divested radars will be used to support the sustainment of the remaining radars in the NAS.

Radar Divestiture Program | Overview

Mission: ***Capitalize on the benefits of new surveillance technologies by strategically reshaping our radar infrastructure to gain efficiencies and optimize services for ATC operations today and into the future.***

Where: **Terminal Radars Only - Across the NAS in areas with multiple layers of overlapping coverage.**

When:

Phase 1: FY2020 - 2025

- Funded by: ADS-B Baseline Services Future Segment (FY20-FY25)
- No acquisition contract required
- Pursue 32 divestitures
  - **Category 1**: 25 full site removals
  - **Category 2**: 7 non-cooperative radar only removal

  14% reduction (32 of 243 systems in the NAS)
- **Terminal systems only** (**ASR-8/9/11, BI-5, Mode S, MSSR**)
- Estimated cost avoidance: **$388M** (Present value / out to 2035)

Phase 2: FY2025 and Beyond *(New Funding Required)*

- Surveillance Portfolio Analysis Group is analyzing the next phase of Radar Divestitures

ADS-B In Retrofit Spacing (AIRS) Evaluation

American Airlines

ACSS
An L3Harris & Thales Company

FEDERAL AVIATION ADMINISTRATION

- **AIRS Evaluation is a project to demonstrate the *operational feasibility* and *value* of ADS-B In capability using a *retrofit solution***
  - AAL equipping all their A321ceo/neo aircraft with avionics from ACSS
  - All operating A321neos are equipped
  - Last A321ceo to be retrofitted will occur during a C-check beginning next month
- **Capabilities being demonstrated:**
  - **CDTI-Assisted Visual Separation (CAVS)**, and limited set of **Interval Management (IM)** capabilities called **Initial Interval Management (I-IM)**
  - Added **CDTI-Assisted Separation (CAS) ~~on~~ Approach** at the request of AAL
- **CAVS operations occurring wherever AAL A321s fly since May 2021**
- **I-IM operations occurring in ZAB airspace for PHX arrivals and overflights since 7-Nov-2022**
- **CAS operations occurring in Dallas TRACON (D10) airspace for DFW arrivals since 1-Mar-2023**

Summary

- The U.S. ADS-B mandate has been in effect since 01/01/2020.
- The ADS-B ground infrastructure deployment is **complete**.
- The FAA continues to leverage ADS-B Out to:
  - Implement Wide Area Multilateration (WAM) rather than Radar
  - Successful deployment of Trajectory-Based Display Mode (TBDM), the backbone for enroute facilities to be able to provide 3NM separation below FL230.
  - Successful deployment of 3NM below FL230 at ARTCC's.
- Continue to enhance operational efficiency and safety in the airspace:
  - Reduce overlapping legacy radar coverage across the NAS.
  - Enhance situational awareness on the airport surface.
  - Reduce 1030/1090 MHz spectrum congestion
  - ADS-B In applications (e.g., CAVS, CAS, etc.)

Questions

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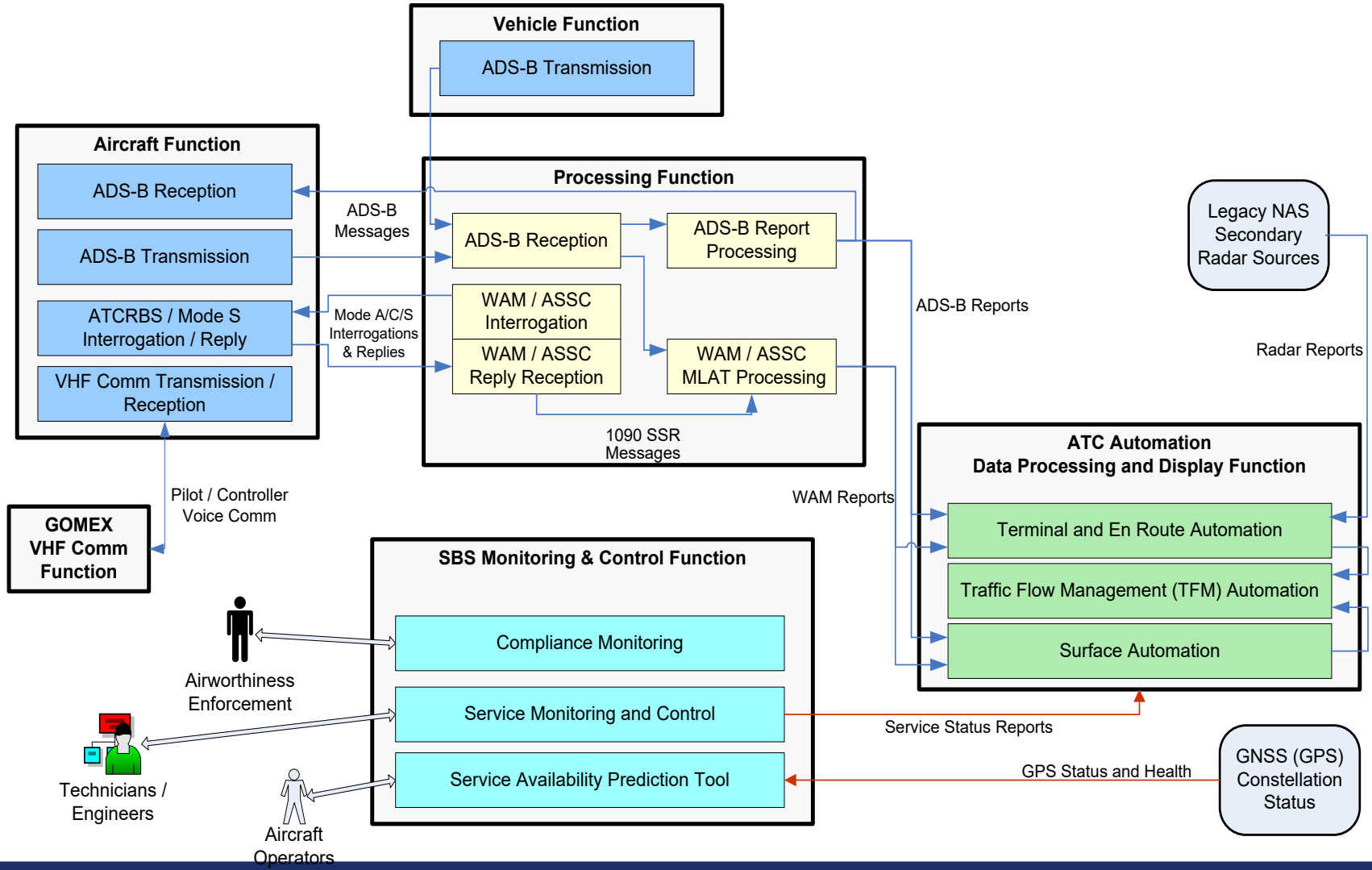
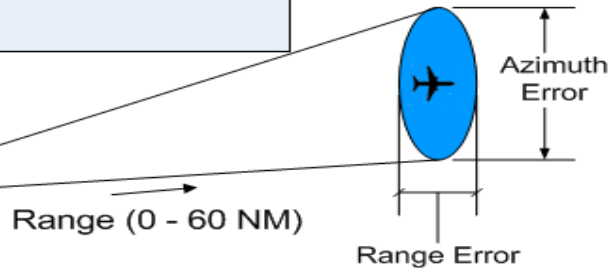
BACKUP SLIDES

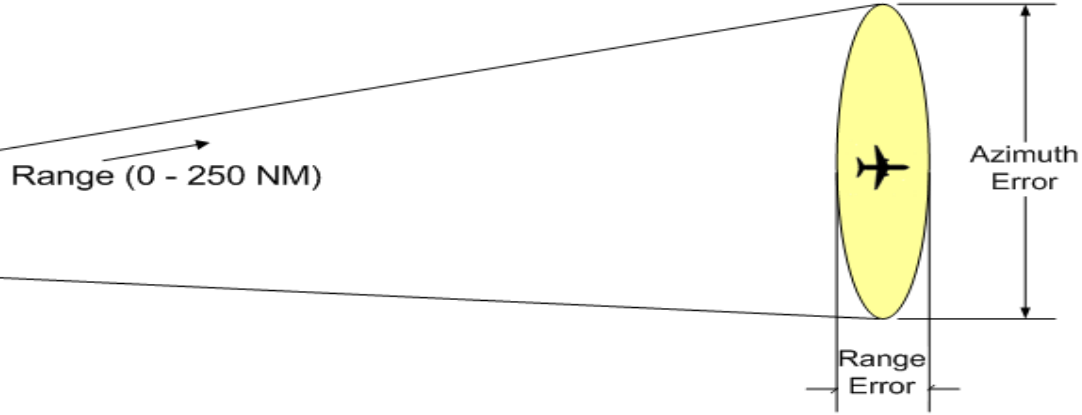
FAA Surveillance Functional Architecture



Sensor Characteristics for Fusion

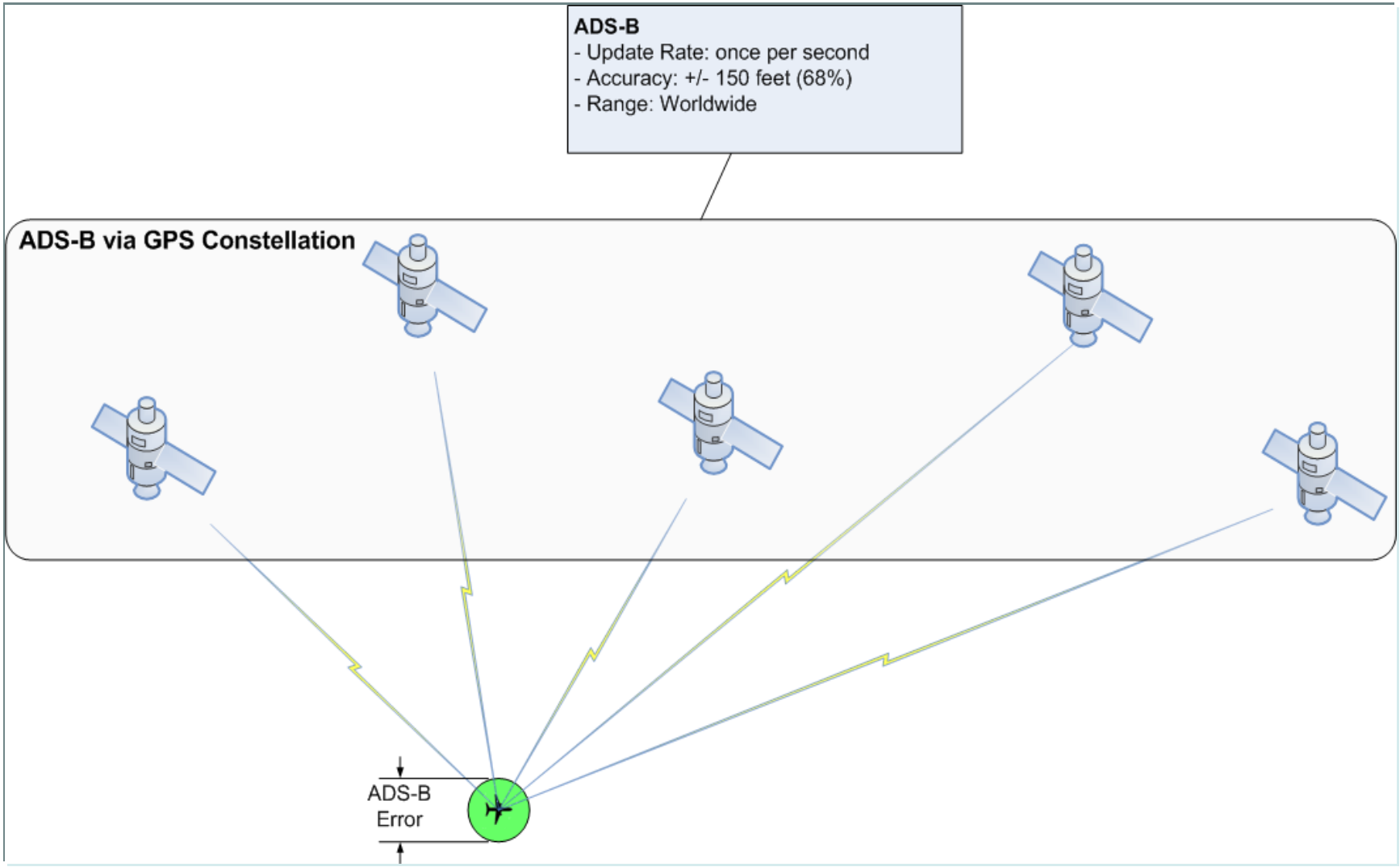
ASR-9/Mode S
- Update Rate: 4.61 seconds
- Range Accuracy: +/- 180 feet (68%)
- Azimuth Accuracy: +/- 637 feet (68%) at 60NM
- Range: 60NM



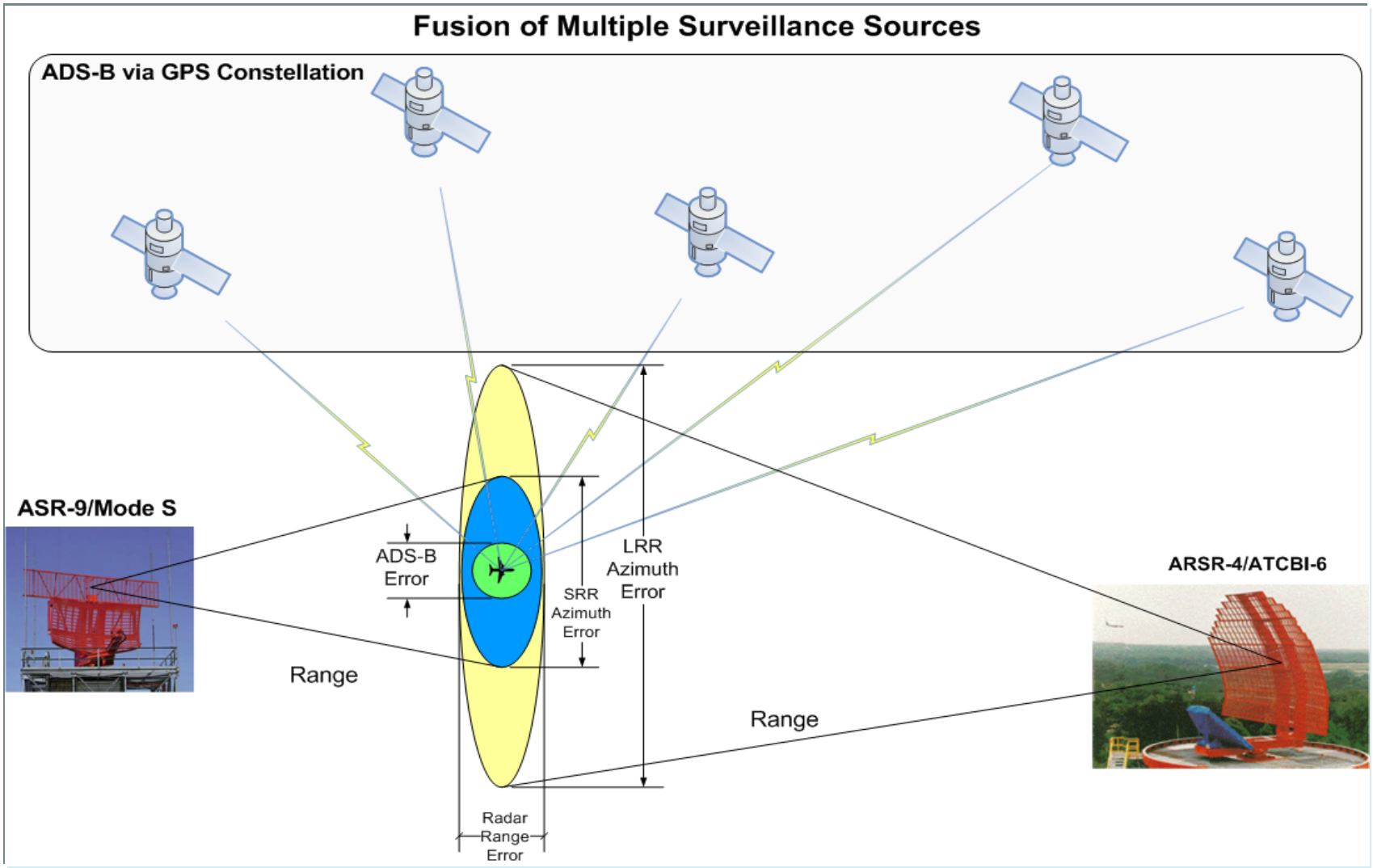


ARSR-4/ATCBI-6
- Update Rate: 12 seconds
- Range Accuracy: +/- 180 feet (68%)
- Azimuth Accuracy: +/- 2652 feet (68%) at 250NM
- Range: 250NM

Sensor Characteristics for Fusion



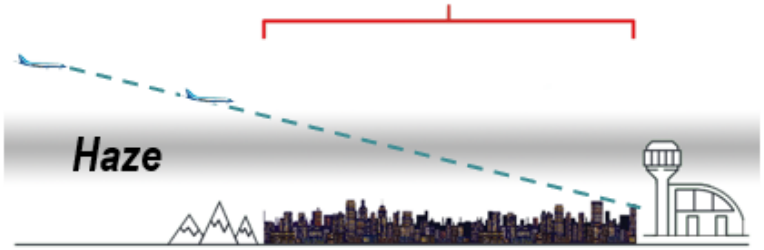
Comparison of Different Sensors



AIRS Project Background

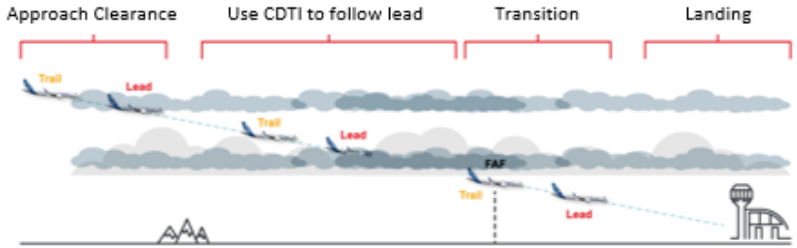
Evaluation of three capabilities

CDTI Assisted Visual Separation (CAVS)

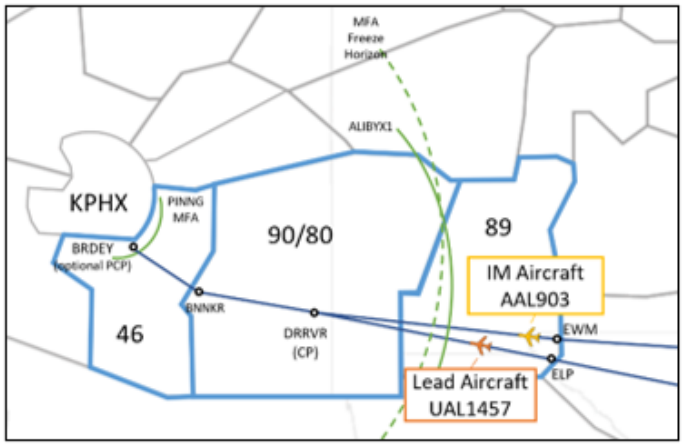


- Flight crews can use CDTI to maintain contact with Traffic-to-Follow (TTF) during challenging visibility situations (Haze, Surface Lights, etc.)
- Flight crews must acquire TTF "out the window" (OTW) first, then can rely on CDTI display

CDTI Assisted Separation on Approach (CAS-A)



- Controller clears aircraft for an approach and instructs CAS-A aircraft to use pilot-applied separation behind lead aircraft
- Flight crew acquires TTF on CDTI with no OTW required
- Airport must be VMC but aircraft can transit IMC to the airport (if on instrument approach)



I-IM: PINNG Arrival into PHX (cross clearance)

Initial-Interval Management (I-IM)

- Controller issues an assigned spacing goal (ASG)
- Pilots use tools in the flight deck to achieve and then maintain ASG
- ASGs can be entered in seconds or miles
- Limited to two clearances – "cross" and "maintain"
- I-IM is used for flights transitioning ZAB airspace as well as for flights on the PINNG and EAGUL arrivals into PHX