Surveillance and Broadcast Services

ENRI International Workshop on ATM / CNS

By: Robert Novia
Date: March 5, 2009
Agenda

• Overview
• Dual Track Strategy
• Program Status
• Rulemaking Status
  – Schedule
• International Harmonization
• Applications
• Acquisitions and Agreements
• Next Steps
Overview: 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
Overview: Traffic Information Service - Broadcast / Flight 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.

FIS-B transmits graphical National Weather Service products, temporary flight restrictions (TFRs), and special use airspace.
Overview: Surveillance and Broadcast Service Descriptions

- **ADS-B**
  - Non-Equipped
  - Surveillance of ADS-B equipped aircraft for Air Traffic Control and Aircraft Situational Awareness
  - Cross-Linking of ADS-B data for Aircraft Situational Awareness

- **ADS-R**
  - Non-Equipped
  - Cross-Linking of ADS-B data for Aircraft Situational Awareness

- **TIS-B**
  - Non-Equipped
  - Uplink of Surveillance Data of Non-ADS-B equipped aircraft for Aircraft Situational Awareness

- **FIS-B**
  - Non-Equipped
  - Uplink of Weather and other Flight Information for UAT Equipped Aircraft
Dual Track Strategy

Ground Infrastructure

Acquisition Planning

Acquisition Execution

Deploy Ground Infrastructure

11/24/2008
Essential Services ISD

Pre-NPRM Separation Standards Modeling

Test Ground Infrastructure / Voluntary Avionics Equipage

Initial Operating Capability

9/2010
Critical Services ISD

Avionics Equipage

RPR Phase I

RPR Phase 2

1/2007
NPRM

RPR Phase 3

4/2010
Final Rule

5/2010
Avionics Equipage Begins

= Completed

= In Process

RPR = Rulemaking Project Record; NPRM = Notice of Proposed Rulemaking; ISD = In-Service Decision

Surveillance and Broadcast Services

Federal Aviation Administration

6
Ground Infrastructure: 794 Ground Station Solution Provides National Coverage

Legend:
- ▲ Tower Site
- Coverage at 1,500 feet (GoMex)
- Coverage at 1,800 feet
- Coverage at 5,100 feet
- Coverage at 10,000 feet
- Coverage at 28,000 feet
## Rulemaking Next Steps: Schedule to Final Rule

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Planned Date of Completion</th>
<th>Status / Comments</th>
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<tbody>
<tr>
<td>FAA Rulemaking Team finalizes RPR Phase 3</td>
<td>January 14, 2009</td>
<td>Complete</td>
</tr>
<tr>
<td>RPR Phase 3 Submitted to ARM</td>
<td>January 21, 2009</td>
<td>Complete</td>
</tr>
<tr>
<td>Rulemaking Council Approval of RPR</td>
<td>January 27, 2009</td>
<td>Complete</td>
</tr>
<tr>
<td>Rulemaking Team Drafts Final Rule</td>
<td>May 2009</td>
<td></td>
</tr>
<tr>
<td>Final Rule Economic Assessment</td>
<td>August 2009</td>
<td></td>
</tr>
<tr>
<td>Final Rule Concurrence through Directors</td>
<td>October 2009</td>
<td></td>
</tr>
<tr>
<td>Final Rule Concurrence through Associates</td>
<td>November 2009</td>
<td></td>
</tr>
<tr>
<td>Final Rule Concurrence through Administrator</td>
<td>December 2009</td>
<td></td>
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<tr>
<td>Final Rule Approved through OST</td>
<td>January 2010</td>
<td></td>
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<tr>
<td>Final Rule Approved through OMB</td>
<td>April 2010</td>
<td></td>
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<tr>
<td>Final Rule Published in Federal Register</td>
<td>April 2010</td>
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• RPR = Rulemaking Project Record
International Harmonization

- **International Civil Aviation Organization (ICAO)**
  - Aeronautical Surveillance Panel (ASP)
  - Separation and Airspace Safety Panel (SASP)
  - Caribbean and South American Regional Planning and Implementation Group (GREPECAS)
  - Asia Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG)

- **Eurocontrol**
  - CASCADE: ADS-B is main focus of CASCADE, standardization, trials and implementation activities are being funded, and it is the largest EUROCONTROL partner in terms of budget and staff
  - Action Plan 23: exchange information and ideas for future airborne applications
  - Airborne Separation Assistance System Thematic Network 2 (ASAS –TN 2): European Commission funded forum

- **Requirements Focus Group (RFG)**
  - Joint RTCA / EUROCAE Working Group

- **Recurring Coordination Meetings**
  - Transport Canada
    - NAV CANADA
  - Civil Aviation Safety Authority
    - Airservices Australia
  - Eurocontrol
# Initial ADS-B Services and Applications

<table>
<thead>
<tr>
<th>Services:</th>
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<tbody>
<tr>
<td>Surveillance Broadcast Services (En Route, Terminal, Surface)</td>
</tr>
<tr>
<td>Traffic / Flight Information Broadcast Services</td>
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<table>
<thead>
<tr>
<th>Applications:</th>
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<tbody>
<tr>
<td>Enhanced Visual Acquisition</td>
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<tr>
<td>Enhanced Visual Approaches</td>
</tr>
<tr>
<td>Final Approach and Runway Occupancy Awareness</td>
</tr>
<tr>
<td>Airport Surface Situational Awareness</td>
</tr>
<tr>
<td>Conflict Detection</td>
</tr>
<tr>
<td>Merging and Spacing</td>
</tr>
<tr>
<td>Cockpit Display of Traffic Information (CDTI) Assisted Visual Separation (CAVS)</td>
</tr>
</tbody>
</table>
Critical Services – Key Sites
Gulf of Mexico, Philadelphia, Louisville, Juneau
ADS-B Out: ATC Separation Services - Current Conditions (High)
ADS-B Out: ATC Separation Services - ADS-B Enabled (High)
**Gulf of Mexico Summary**

<table>
<thead>
<tr>
<th><strong>Infrastructure</strong></th>
<th><strong>Service Volumes – (Communications and Surveillance)</strong></th>
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<tbody>
<tr>
<td>• Approximately 22 ADS-B ground stations located on oil platforms and along the shore</td>
<td>• Low Altitude En Route Service Volume</td>
</tr>
<tr>
<td>• Approximately 35 Weather sensor stations</td>
<td>-1,500 ft. - 3,000 ft. above mean sea level (MSL) over oil/gas platforms</td>
</tr>
<tr>
<td>• 12 existing communication stations</td>
<td></td>
</tr>
<tr>
<td>• 7 new communication stations</td>
<td>• High Altitude En Route Service Volume</td>
</tr>
<tr>
<td></td>
<td>– Floor: 28,000 ft. MSL, Ceiling: 60,000 ft. MSL</td>
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<thead>
<tr>
<th><strong>Services</strong></th>
<th><strong>Service Delivery Points (SDP)</strong></th>
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<tbody>
<tr>
<td>• Air traffic control separation services</td>
<td>• Primary SDP: HOST / ERAM at Houston Center</td>
</tr>
<tr>
<td>– ADS-B / ADS-R for Low Altitude up to 24,000 ft.</td>
<td></td>
</tr>
<tr>
<td>– ADS-B 1090-ES only for High Altitude above 24,000 ft.</td>
<td></td>
</tr>
<tr>
<td>• VHF Voice Communications (Air to Ground)</td>
<td></td>
</tr>
<tr>
<td>• Automated Weather Observation Services</td>
<td></td>
</tr>
<tr>
<td>• Flight Information Broadcast Services (FIS-B) Product Set 2</td>
<td></td>
</tr>
<tr>
<td>Low Altitude</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Benefits</strong></th>
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<tbody>
<tr>
<td>• High altitude</td>
</tr>
<tr>
<td>– Increased capacity and Optimal routing</td>
</tr>
<tr>
<td>• Low altitude</td>
</tr>
<tr>
<td>– Increased capacity and Reduction in weather related accidents</td>
</tr>
</tbody>
</table>

**Surveillance and Broadcast Services**
Essential Services: Miami

- Lakeland Linder Regional Airport
- Univision – TV Tower
- Sebastian Municipal Airport
- Okeechobee – Telecom Tower
- Hobe Sound – Telecom Tower
- Boca Raton Airport
- Hardee – Telecom Tower
- Dade-Collier Airport
- Beach – TV Tower (Key West)
- Florida Keys Marathon Airport
- Dade Marina – Telecom Tower (Homestead)
ADS-B In: Program Baseline - Enhanced Visual Acquisition
ADS-B In: Program Baseline - Enhanced Visual Approaches
ADS-B In: Program Baseline - Final Approach and Runway Occupancy
ADS-B In: Program Baseline - Airport Surface Situational Awareness
Note: Working Group 1 will not have the complete set of documents complete prior to In-Service Decision.
ADS-B In: Program Baseline - Merging and Spacing
$9.3M Acquisition

• The FY08 Conference Report accompanying H.R. 3074 has provided additional funding to the ADS-B program "specifically to expedite air to air capabilities"

• FAA intends to utilize this funding to demonstrate ADS-B capabilities in the areas of surface conflict detection and cockpit alert capabilities
Surface Conflict Detection and Cockpit Alerting
$9.3M Acquisition: Awards

On November 3, 2008 the FAA announced awards to two different vendors

Honeywell

ACSS
$9.3M Acquisition: Honeywell Award

- **Award:** $3M
- **Proposal:** Develop requirements, standards and human factors analysis
- **Location(s):**
  - Seattle Tacoma
  - Snohomish County Paine Field
- **Aircraft (experimental):**
  - 1 Cessna Sovereign
  - 1 Beechcraft King
- **Display:** EFB and MFD
- **Pilots:**
  - JetBlue Airways
  - Alaska Airways
**$9.3M Acquisition: ACSS Award**

- **Award**: $6M
- **Proposal**: Create standards, flight demonstrations and prototypes
- **Partner**: US Airways
- **Location**: Philadelphia
- **Aircraft (2 experimental, 19 revenue service)**:
  - King Air C90 (1)
  - Airbus 330 (20)
- **Display**: Class 2 EFB / AGD
Other Agreements: NextGen

• January 13, 2009 agreement between FAA, US Airways and ACSS
  – Agreement establishes a public-private collaboration to develop a plan and endeavor to establish subsequent agreements to integrate implementation of Next Generation Air Transportation System (NextGen) capabilities in selected locations in the National Airspace System (NAS)
  – First Agreement Implementation Committee (AIC) meeting is scheduled for February 2, 2009
## Next Steps: FY2009 / FY2010 Schedule

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Planned Date of Completion / Status</th>
</tr>
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<tbody>
<tr>
<td><strong>FY2009</strong></td>
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</tr>
<tr>
<td>Louisville Service Acceptance Test (SAT)</td>
<td>April 2009</td>
</tr>
<tr>
<td>Gulf of Mexico Weather Service Acceptance Test (SAT)</td>
<td>June 2009</td>
</tr>
<tr>
<td>Gulf of Mexico Service Acceptance Test (SAT)</td>
<td>June 2009</td>
</tr>
<tr>
<td>Philadelphia Service Acceptance Test (SAT)</td>
<td>August 2009</td>
</tr>
<tr>
<td>Gulf of Mexico Comm. and Weather Initial Operating Capability (IOC)</td>
<td>September 2009</td>
</tr>
<tr>
<td><strong>FY2010</strong></td>
<td></td>
</tr>
<tr>
<td>Juneau Service Acceptance Test (SAT)</td>
<td>October 2009</td>
</tr>
<tr>
<td>Louisville IOC of Surveillance Services</td>
<td>October 2009</td>
</tr>
<tr>
<td>Gulf of Mexico IOC of Surveillance Services</td>
<td>December 2009</td>
</tr>
<tr>
<td>Philadelphia IOC of Surveillance Services</td>
<td>February 2010</td>
</tr>
<tr>
<td>Juneau IOC of Surveillance Services</td>
<td>April 2010</td>
</tr>
<tr>
<td>Final Rule Published</td>
<td>April 2010</td>
</tr>
<tr>
<td>Surveillance Services ISD for ADS-B</td>
<td>September 2010</td>
</tr>
</tbody>
</table>
Backup
Spectrum Analysis: Background

• Spectrum Risk Identified: February 2006
  – Due to the numerous ATC systems competing for 1090 MHz spectrum along with the potential growth of air traffic contributing additional 1090 MHz users to the environment, the possibility exists that the 1090 MHz frequency will be congested to the point that existing and future systems will not meet the required performance levels to conduct air traffic and other surveillance related NAS operations.

• Completion of Phase 1 Spectrum Analysis Report: August 2008
  1. Removal of Terra Fix (as recommended prior to 2020)
  2. Reduction of Mode S Interrogation Sequence (as recommended prior to 2020)
  3. Removal of SSRs as outlined in SBS backup strategy (per FAA Enterprise Architecture initial removal list)

Note: Studies have shown that there is not an issue with radar or multilateration. The only issue identified is with TCAS.
Spectrum Analysis: Phase 2 Analysis

Goals

• Assess Performance of 1090 MHz systems (ADS-B, TCAS, SSR) in 2035

• Assess ADS-B Air-to-Air Performance for ranges of 20 NM, 45 NM, 60 NM, and 90 NM
  – 95% Update Rate at 20 NM < 7 sec (ADS-B MASPS)
  – 95% Update Rate at 40-90 NM < 12 sec (ADS-B MASPS)
## Spectrum Analysis: Initial Look at Mitigating 2035 Interference Environment

<table>
<thead>
<tr>
<th>Case</th>
<th>Mode S</th>
<th>ATCRBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>14,558</td>
<td>68,009</td>
</tr>
<tr>
<td>All SSR to Monopulse</td>
<td>14,558</td>
<td>33,367</td>
</tr>
<tr>
<td>TCAS Hybrid Surv.²</td>
<td>11,004</td>
<td>68,009</td>
</tr>
<tr>
<td>Remove all SSRs (Passive Multilat)¹</td>
<td>12,286</td>
<td>3,714</td>
</tr>
<tr>
<td>Remove all SSRs + TCAS Hybrid Surv.²</td>
<td>9,271</td>
<td>3,714</td>
</tr>
<tr>
<td>Change all SSRs and AC to Mode S</td>
<td>19,800</td>
<td>0</td>
</tr>
</tbody>
</table>

Notes:
1. Calculated with revised assumptions (e.g. Passive MLAT can be performed on both UAT and 1090-ES)
2. Assumes 60% reduction in TCAS interrogations when aircraft implement hybrid surveillance. Does not consider TCAS Hybrid Surveillance using UAT.

[Link to 2035 Interference](#)
Spectrum Analysis: Next Steps

- **ADS-B Air to Air**
  - Performance Results were confirmed by comparing two analyses (JHU/APL and LL)
    - Follow-on efforts will compare all cases for final results

- **Additional Mitigations to Consider**
  - ADS-B only TCAS
  - Using ADS-R to do TCAS Hybrid Surveillance

- **Identify break-point for when the baseline interference does not support the applications**

- **Briefing of Results to Aviation Rulemaking Committee**
  - February 24 (tentative)