

ATO Program Management Organization

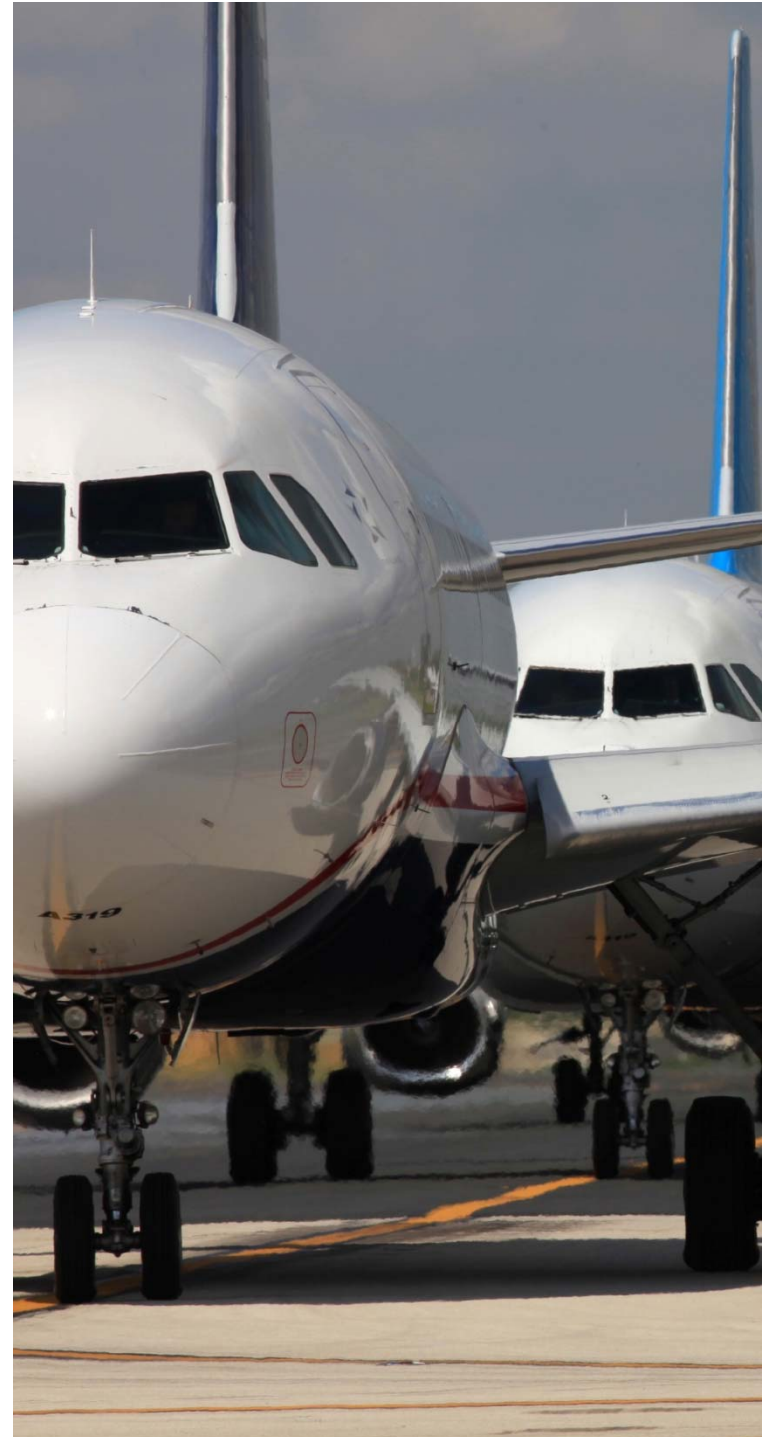
ADS-B Program “Best Practices”

ICAO NAM/CAR/SAM ADS-B

Presented to: Implementation Meeting & Workshop

By: Tim Schroeder

Date: September 2017



Agenda

- **ADS-B as part of a CNS Strategy**
- **Engagement with stakeholders**
- **Case Study: US ADS-B Program**
- **Contingency Planning**
 - GPS denial of service
 - ADS-B Spoofing



ADS-B as part of a CNS Strategy

- **Surveillance Strategy for an airspace region should include consideration of ADS-B (along with radar and MLAT)**
- **Surveillance Strategy must be part of an overall CNS Strategy for an airspace region**
 - C = Communications; N = Navigation
 - CNS capability determines offerable Air Traffic Services
- **Consider current/future traffic demand, current/planned ATC automation systems, available & future resources, and operating domains (Oceanic, En Route, Terminal, Surface)**



Some possible uses of ADS-B

- **ATC separation**

1. Principal source of cooperative surveillance (replaces one or more cooperative surveillance radars)
2. Principal source of cooperative surveillance in airspace that previously had no cooperative surveillance coverage
3. Used to cover “gaps” in coverage of existing cooperative surveillance radar
 - Part of an integrated Wide Area Multilateration (WAM) system to perform 1 or 2

- **ATC “situation awareness”**

- Used for traffic awareness only – still ATC procedural separation

- **Airport surface**

- Sole source of cooperative surveillance for an airport surface that previously had no cooperative surveillance coverage
- Part of an integrated surface multilateration system



Stakeholder Engagement

Stakeholders– who are they?

- **Internal Stakeholders**

- ANSP (Air Traffic Control service provider)
- Civil Aviation Authority (regulator)

- **External Stakeholders**

- Aircraft owners/operators
- Industry; manufacturers of
 - ATM systems or related components
 - Aircraft or Aircraft components
- Airport owner/operators (if not included above)
- Public



Stakeholder Engagement

What do they want to know?

- What changes are you proposing?
- How much would it cost?
- How long would it take?
- What are the benefits?
- What are the risks?
- What does it mean to me?
(to the specific Stakeholder asking...)



Case Study: US ADS-B Program

Stakeholder engagement (1 of 5)

- **Why an airspace mandate?**

- ADS-B to become principal source of cooperative surveillance information in US (NextGen vision)
- ADS-B Out equipage needed to enable
 - ADS-B-In applications
 - Removal of most legacy cooperative surveillance systems

- **Is this worth doing (do benefits outweigh cost)?**

- FAA took total cost/benefit perspective – “total” is the sum of government & private sector costs / benefits
- Focus of most interactions with stakeholders
 - How to increase total benefits – while ensuring each stakeholder could see benefits for themselves
 - How to lower total costs – while considering each stakeholder’s costs



Case Study: US ADS-B Program

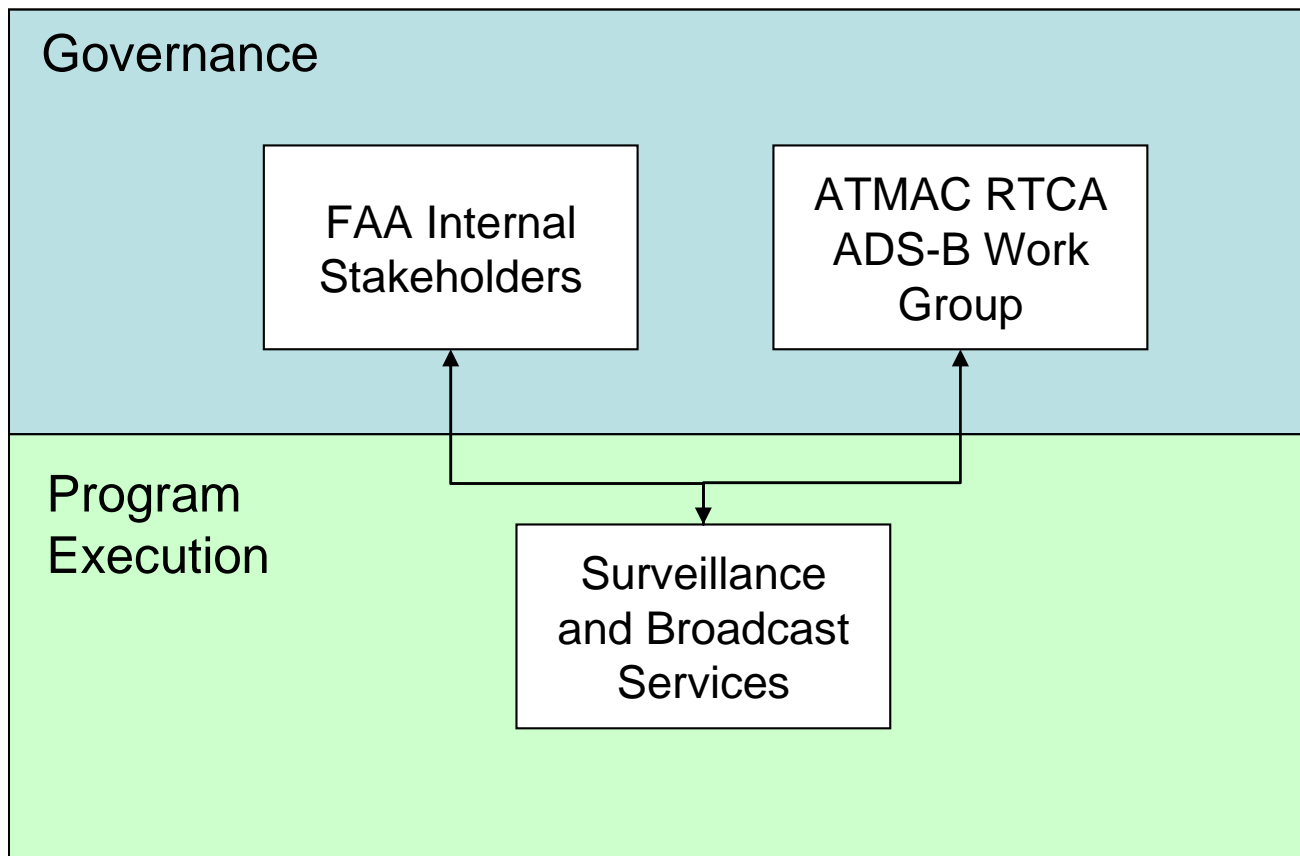
Stakeholder engagement (2 of 5)

RTCA Air Traffic Management Advisory Committee (ATMAC)

- ADS-B Work Group to advise FAA during “design” of FAA’s implementation program
- Initial governance and strategy formulated
- FAA proposal for an airspace mandate



Program Governance (2006)



FAA use of ADS-B

- **ATC separation**

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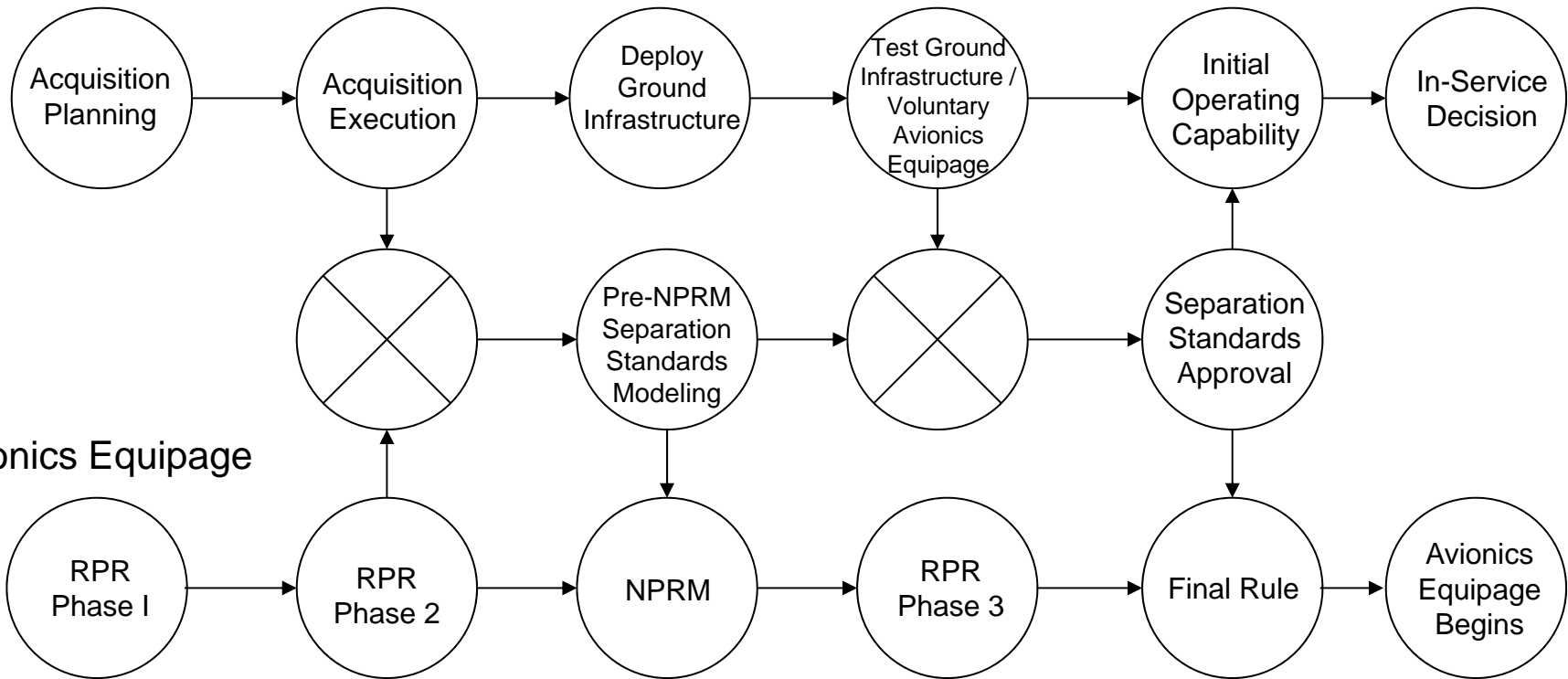
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“Dual Track” Strategy (2006)

Ground Infrastructure



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



Case Study: US ADS-B Program

Stakeholder engagement (3 of 5)

Aviation Rulemaking Committees (ARC)

– ADS-B “Out” [2007-2008]

<https://www.faa.gov/nextgen/programs/adsb/media/arcReport2008.pdf>

- Advise FAA on dispositioning comments on US airspace mandate proposal
- Led to FAA revisions of the final airspace mandate

– ADS-B “In” [2010-2012]

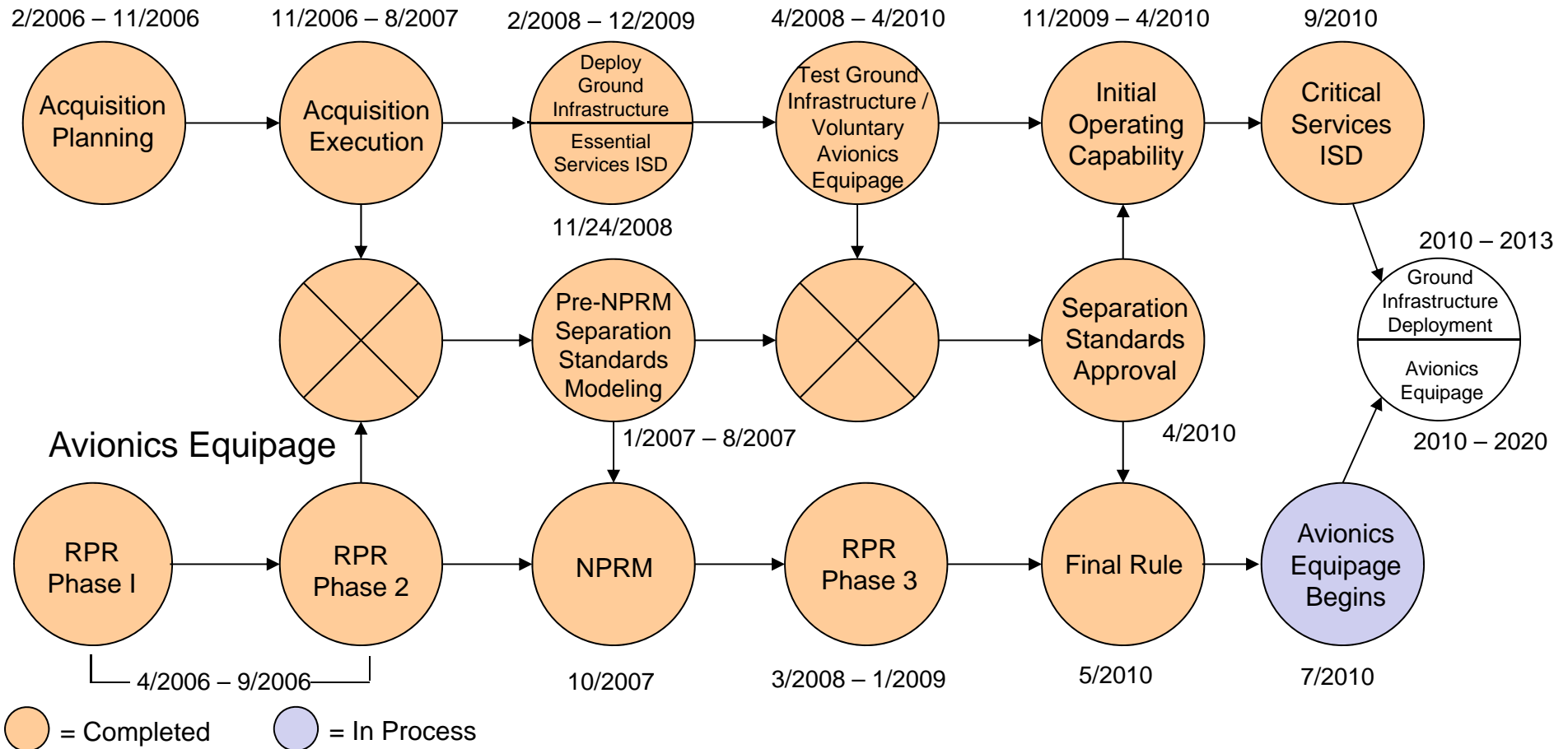
<https://www.faa.gov/nextgen/programs/adsb/media/ADS-BInARCReportOct2012.pdf>

- Recommendation from ADS-B “Out” ARC
- Advise FAA on ADS-B-In strategy



Strategy (Sept 2010)

Ground Infrastructure



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Case Study: US ADS-B Program

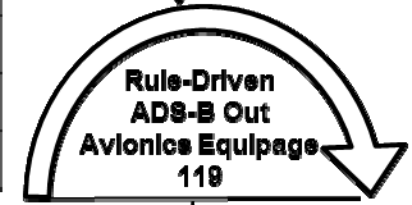
Stakeholder engagement (4 of 5)

Joint Industry ADS-B Working Group [2011-2014]

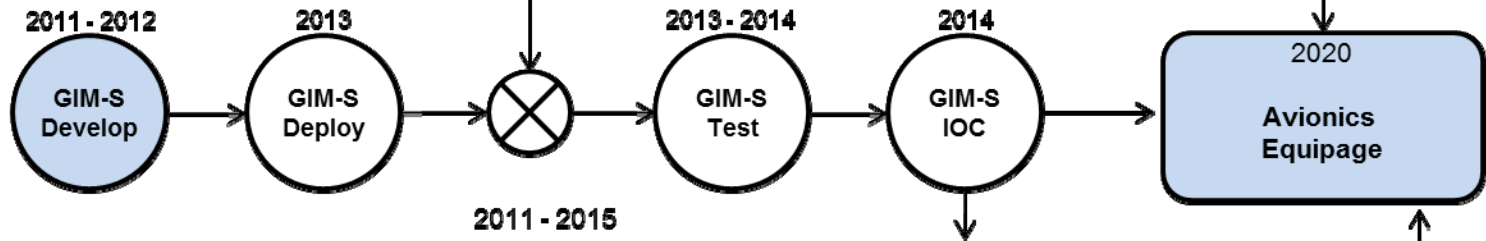
- Industry-led forum for engaging with FAA ADS-B Program during implementation, after final publication of airspace mandate
- Discussion topics included implementation of ADS-B Out (both from an ATC perspective and an avionics perspective) and development of ADS-B-In applications
- Inspired FAA projects to incentivize early ADS-B equipage, to exercise FAA certification processes (ADS-B Out and In) and operational approval processes (certain ADS-B-In applications)



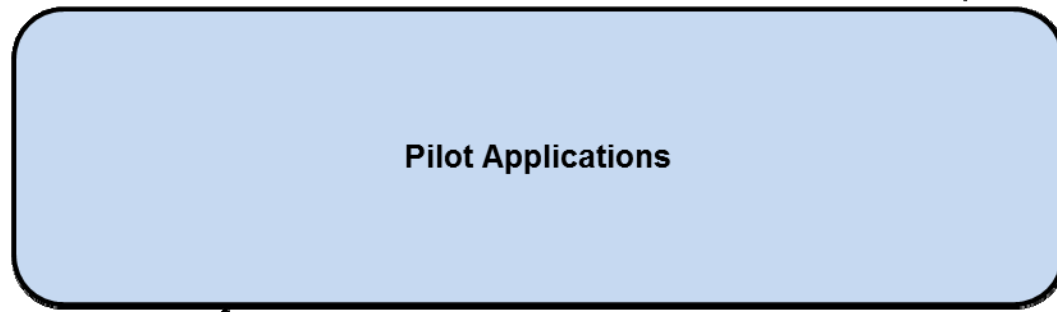
| Service Delivery Points for ATC Separation Services | | | | | | | | | |
|---|------|------|------|------|------|------|------|------|-------------|
| | FY10 | FY11 | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | Operational |
| En Route | 2 | 0 | 4 | 15 | 3 | 0 | 0 | 0 | 2 of 24 |
| Terminal | 2 | 1 | 16 | 45 | 52 | 43 | 0 | 0 | 3 of 159 |
| Surface (Advisory) | 2 | 0 | 14 | 15 | 5 | 1 | 5 | 2 | 2 of 44 |



ATC Spacing Services
Ground-Based Interval Mgmt - Spacing (GIM-S) (En Route only)

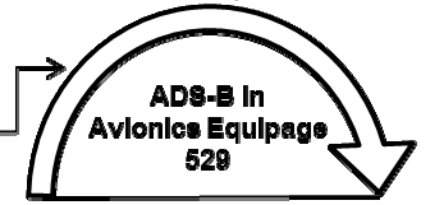


Flight Deck Based Interval Mgmt - Spacing (FIM-S)
In Trail Procedures (ITP)
Traffic Situation Awareness with Alerts (TSAA)

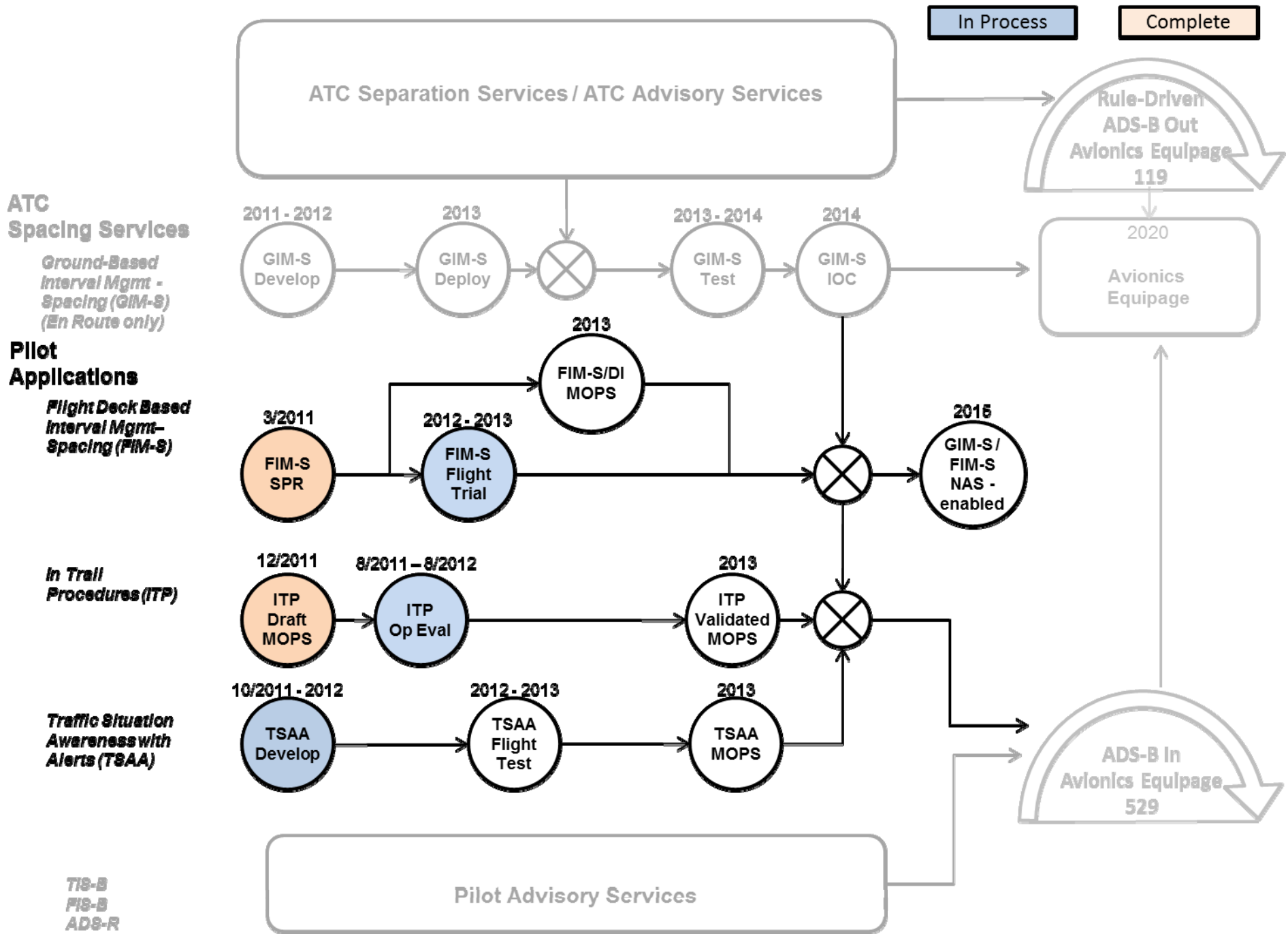


| Pilot Advisory Services | | | | | | | | |
|-----------------------------|------|------|------|------|-----------|------|------|------------------|
| | FY08 | FY09 | FY10 | FY11 | FY12 | FY13 | FY14 | Actual / Planned |
| Radio Station Installations | 11 | 43 | 211 | 101 | 52 of 134 | 184 | 46 | 418 of 730 |
| Operational Radio Stations | 371 | | | | | | | |

TIS-B
FIS-B
ADS-R



As of 3-23-2012



Case Study: US ADS-B Program

Stakeholder engagement (5 of 5)

Equip 2020 [2014-present]

- FAA Leadership hosted over 80 industry representatives at an ADS-B “Call to Action” meeting on 28-Oct-2014 to identify barriers to equipping for ADS-B Out airspace mandate
- Participants identified a number of barriers
 - 32 actions were identified, to be further worked by industry/FAA under an initiative called “Equip 2020”
- Equip 2020 meetings consist of a Plenary and Working Group meetings – all within a single day
 - Meetings were initially every month; now are every 3 months



Equip 2020 Working Groups

- Group 1 – Air Carrier Equipage: coordinate and monitor ADS-B Out equipage in Part 121 and 135 community, tackling issues relevant to availability of equipment and its installation
- Group 2 – General Aviation Equipage: coordinate and monitor ADS-B Out equipage in General Aviation community, tackling issues relevant to availability of equipment and its installation
- Group 3 – GPS Receiver and Performance-Based Rule Implications: define opportunities for sharing risks of using unaugmented GPS equipment for a limited time sufficient for certain operators to equip with SBAS or multi-constellation receivers
*Group delivered product in Dec 2014 and disbanded
=> ultimately led to FAA Exemption 12555*
- Group 4 – Education and Benefits: coordinate education and outreach to community concerning ADS-B Out requirements and benefits
This Group was merged into Group 2 in 2016
- Group 5 – Installation and Approvals: address issues associated with ensuring efficient and consistent installations and approvals



Equip 2020 Update – June 2017

- **Air Carrier Community Highlights**
 - Evaluating performance of GPS-inertial integrated solutions
 - Advocating for completion of modernized GNSS receiver standards
 - Maturing Service Availability Prediction Tool
 - Discussing DO-260B equipage plans and Exemption 12555
- **General Aviation Community Highlights**
 - Updating information on target aircraft for equipage
 - AEA conducting survey of repair station capacity
 - Resolving aerobatic aircraft performance
 - Discussion progress of GA Rebate Program
 - Discussing privacy concerns for aircraft equipped with Mode S transponders and/or ADS-B systems





GPS Outages and Signal Jamming (Denial of Service):

Mitigation Approaches: Procedures, Radar/MLAT, Monitoring, and Independent Position Validation:

- Procedures: implement increase in separation (if needed) when outages occur
- Radar/MLAT:
 - FAA will maintain about half of current secondary radars as a back-up system throughout en route and high density terminal airspace
 - FAA has implemented integrated MLAT/ADS-B systems in the CLT and LAX terminal areas; MLAT function serves as a backup to large-scale ADS-B failure
 - FAA uses primary radar to mitigate single-aircraft avionics failures
- Monitoring: FAA has an active monitoring process to verify that each automation feed remains in tolerance -- any anomalies are investigated and resolved
- Independent Position Validation: *See next slide*





Spoofing (False Target Attacks)

Mitigation Approach: Multiple, independent aircraft position determination strategies to determine when an ADS-B signal is being broadcast from one location while sending out inaccurate location information

- Independent position validation is accomplished using multiple methods:
 1. Independent cooperative surveillance (SSR/MLAT)
 2. Time Difference of Arrival (TDOA) (for Universal Access Transceiver, ranging to a ground station is also available)
 - FAA/Harris system utilizes almost 700 ground stations, providing significant coverage overlap to support TDOA validation requirements at en route altitudes
- Targets that are determined to be “invalid” (not in agreement with independent position validation) are automatically filtered and not used for tracking or display to Air Traffic Control (ATC).
- Targets that are “Valid” or “Unknown” are accepted for tracking and display (“Unknown” condition is a short term state until validation process makes a determination)



BACKUP



Final Rule Business Case

- Benefits in the Final Rule (High Benefits BY2007)

| Benefit Area | Benefit 2007 MS |
|--|-----------------|
| Total Benefits | \$9,948.5 |
| Gulf of Mexico | |
| High Altitude Operations | \$2,067.2 |
| More Efficient En Route Separation | |
| Delay Savings | \$1,810.6 |
| Additional Flights Accommodated | |
| Optimal and More Direct Routing | \$256.6 |
| Improved En Route Conflict Probe Performance | \$3,258.1 |
| More Efficient Metering Based on Improved TMA Accuracy | \$1,746.6 |
| Increased Ability to Perform Continuous Descent Approaches | \$2,876.7 |



Final Rule Business Case

- Additional benefits quantified in FAA business case but not in Final Rule
 - Low Altitude Gulf of Mexico increased capacity
 - Increased surface safety and efficiency (at ASDE airports)
 - Improved Search and Rescue
- Additional benefits have been discovered throughout the implementation of ADS-B Out
 - Expanded surveillance coverage beyond radar airspace
 - Backup for radar outages
 - ADS-B only surveillance has been successfully used to allow ADS-B Out equipped flights access to offshore East Coast Routes (M201/L453) during radar outages that would normally close those routes
 - Fusion of surveillance sources for use in automation
 - Has been successfully used to avoid disruptions caused by radar outages at Atlanta and Boston
 - Has been used at many terminal facilities to fill in surveillance gaps that were prevalent when using single sensor mode and extend the use of 3 nmi separation



Final Rule Business Case

- FAA pursuing additional investments to further increase benefits of ADS-B out
 - Additional coverage areas
 - Caribbean and Alaska with unreliable or limited current surveillance
 - Oceanic FIRs
 - Additional non-radar terminal locations
 - Additional surface surveillance (at non-ASDE airports)
 - Reduction of en route separation to 3nm to increase airspace capacity and reduce potential conflicts, delays or fuel burn caused by conflict avoidance maneuvers
 - Enabling additional ADS-B In applications to provide additional benefits

