

U.S. Progress in ADS-B Systems Development and Implementation

3rd ENRI International
Workshop on ATM/CNS

February 20, 2013

Presenter: Mark Reeves

Author: Doug Arbuckle

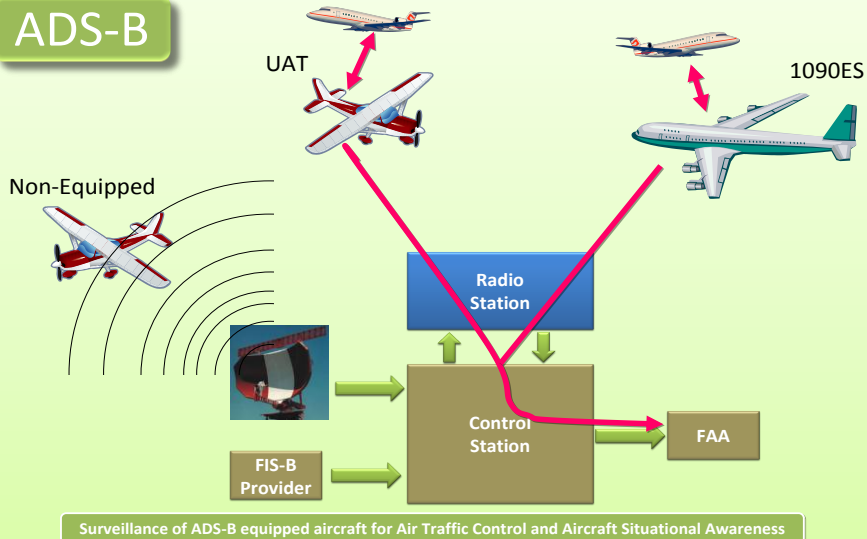


Federal Aviation
Administration

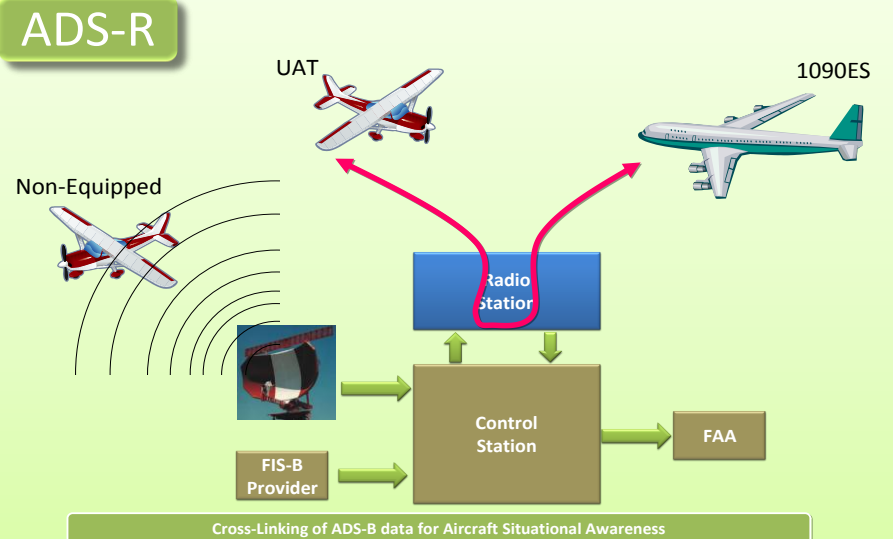


ADS-B Service Architecture

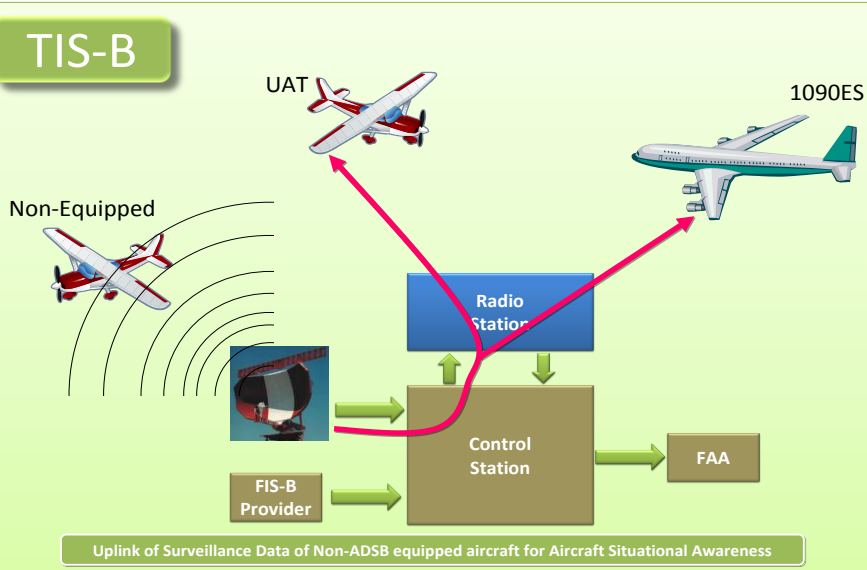
ADS-B



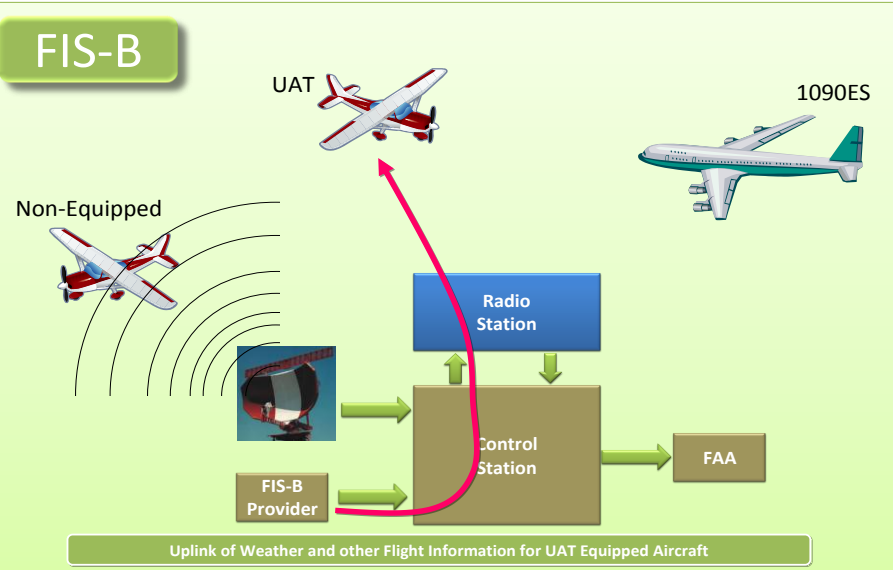
ADS-R



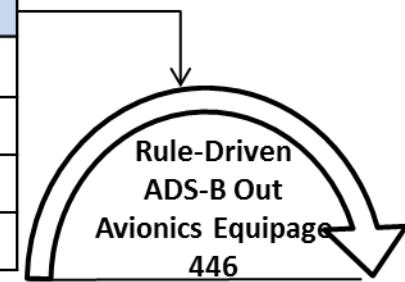
TIS-B



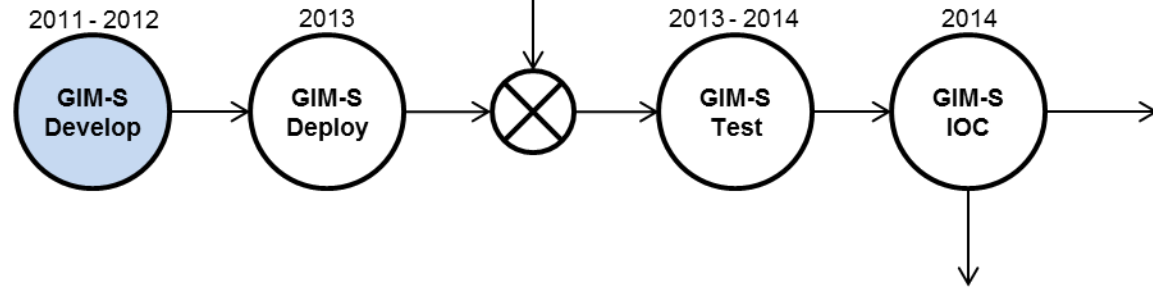
FIS-B



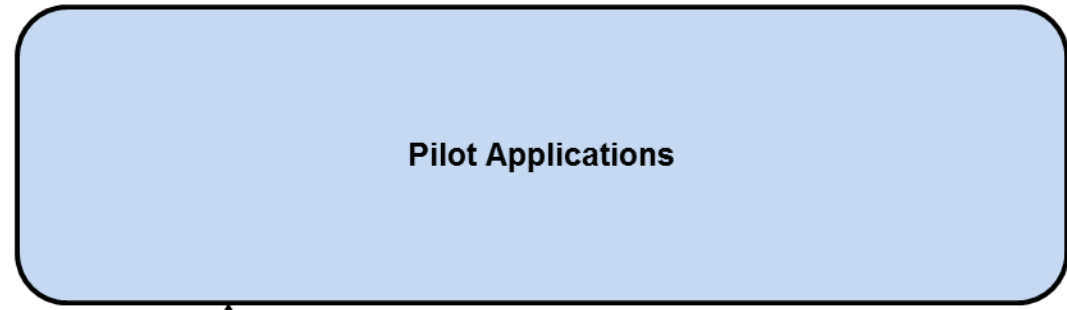
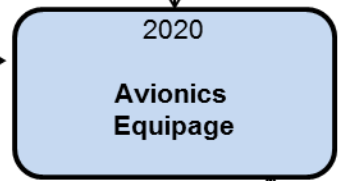
Service Delivery Points for ATC Separation Services									
	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	Operational
En Route	2	0	4	12	6	0	0	0	6 of 24
Terminal	2	1	16	12 of 31	*	*	*	*	31 of 159
Surface (Advisory)	2	0	14	15	5	1	5	2	16 of 44



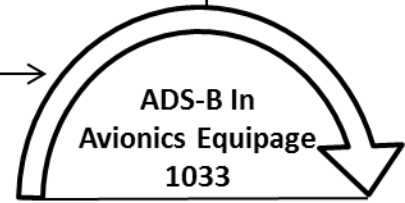
*Under review based on recent TAMR JRC decision



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)



TIS-B
FIS-B
ADS-R

Pilot Advisory Services								
	FY08	FY09	FY10	FY11	FY12	FY13	FY14	Actual / Planned
Radio Station Installations	11	43	211	101	136	30 of 182	46	532 of 730
Operational Radio Stations	445							



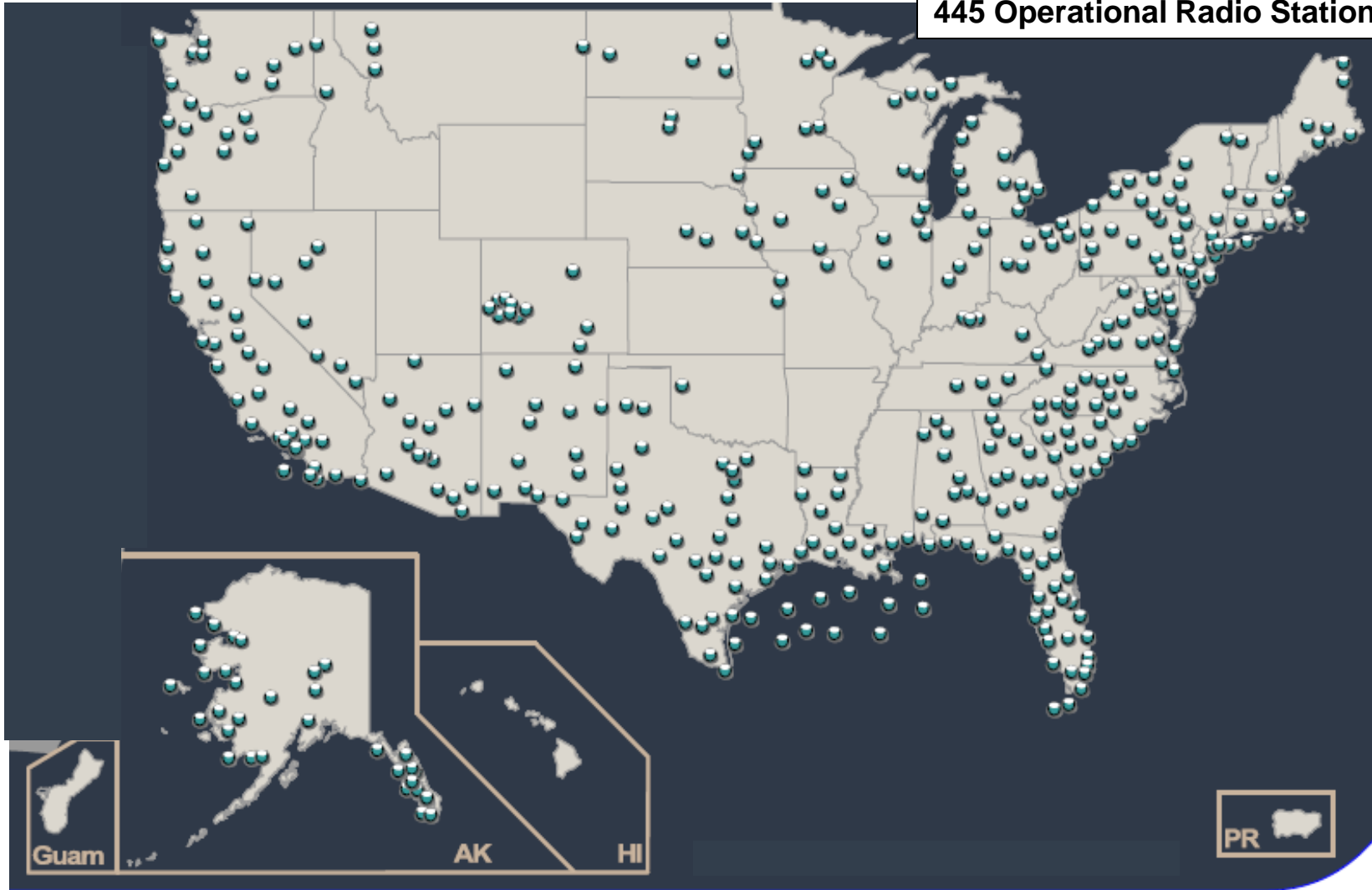
As of 2-4-2013

Implementation Status

February 4, 2013

<http://www.faa.gov/nextgen/flashmap/>

445 Operational Radio Stations



Federal Aviation
Administration

FY13 En Route Sites (12 ERAM sites)

	Site	SBS Infrastructure Complete	Pilot Advisory Services	Automation Ready	ADS-B IOC
1	Chicago (ZAU)	Complete	Complete	Complete	February 2013
2	New York (ZNY)	Complete	Complete	Complete	March 2013
3	Boston (ZBW)	Complete	Complete	Complete	March 2013
4	Cleveland (ZOB)	Complete	Complete	Complete	May 2013
5	Washington (ZDC)	Complete	Complete	February 2013	May 2013
6	Indianapolis (ZID)	Complete	March 2013	Complete	June 2013
7	Miami (ZMA)	Complete	Complete	August 2013	August 2013
8	Kansas City (ZKC)	April 2013	August 2013	Complete	August 2013
9	Memphis (ZME)	April 2013	August 2013	March 2013	August 2013
10	Ft. Worth (ZFW)	Complete	April 2013	June 2013	August 2013
11	Oakland (ZOA)	Complete	Complete	Complete	September 2013
12	Los Angeles (ZLA)	Complete	Complete	Complete	September 2013
13	Atlanta (ZTL)	Complete	Complete	June 2013	FY2014
14	Jacksonville (ZJX)	Complete	Complete	September 2013	FY2014
15	Salt Lake City (ZLC)	October 2013	February 2014	Complete	FY2014

As of 1/23/2013



FY13 Terminal Sites: 31 sites (3 CARTS, 28 STARS)

	Site	SBS Infrastructure Complete	Pilot Advisory Services	Automation Ready	ADS-B IOC	ATC Separation Services Operational
1	Atlanta (ATL)	Complete	Complete	Complete	February 2013	June 2013
2	Potomac (PCT)	Complete	Complete	Complete	March 2013	May 2013
3	Chicago (C90)	Complete	March 2013	Complete	March 2013	Complete
1	Orlando (MCO)	Complete	Complete	Complete	Complete	Complete
2	Cleveland-Hopkins (CLE)	Complete	Complete	Complete	Complete	Complete
3	Jacksonville (JAX)	Complete	Complete	Complete	Complete	Complete
4	Pensacola (P31)	Complete	Complete	Complete	Complete	Complete
5	Charlotte (CLT)	Complete	Complete	Complete	Complete	Complete
6	Tucson (U90)	Complete	Complete	Complete	Complete	Complete
7	Norfolk (ORF)	Complete	Complete	Complete	Complete	Complete
8	Raleigh-Durham (RDU)	Complete	Complete	Complete	Complete	Complete
9	Pittsburgh (PIT)	Complete	Complete	Complete	Complete	February 2013
10	Phoenix (P50)	Complete	Complete	Complete	Complete	Complete
11	Santa Barbara (SBA)	Complete	Complete	Complete	Complete	February 2013
12	Albany (ALB)	Complete	March 2013	Complete	March 2013	March 2013
13	Milwaukee (MKE)	Complete	March 2013	February 2013	March 2013	March 2013

CARTS

STARS

As of 1/23/2013



FY13 Terminal Sites: 31 sites (3 CARTS, 28 STARS)

	Site	SBS Infrastructure Complete	Pilot Advisory Services	Automation Ready	ADS-B IOC	ATC Separation Services Operational
14	Bradley-Windsor (Y90)	Complete	Complete	February 2013	March 2013	March 2013
15	Syracuse (SYR)	Complete	Complete	Complete	March 2013	April 2013
16	Columbus (CMH)	Complete	February 2013	February 2013	March 2013	April 2013
17	Indianapolis (IND)	Complete	Complete	March 2013	March 2013	April 2013
18	Detroit (D21)	Complete	Complete	Complete	March 2013	February 2014*
19	Nashville (BNA)	Complete	March 2013	March 2013	April 2013	April 2013
20	Tampa (TPA)	Complete	Complete	February 2013	April 2013	May 2013
21	Memphis (M03)	Complete	March 2013	April 2013	April 2013	May 2013
22	Lubbock (LBB)	Complete	April 2013	May 2013	May 2013	June 2013
23	Little Rock (LIT)	Complete	May 2013	May 2013	June 2013	June 2013
24	Birmingham (BHM)	Complete	April 2013	April 2013	June 2013	July 2013
25	Covington-Cincinnati (CVG)	Complete	May 2013	May 2013	June 2013	July 2013
26	Omaha (R90)	March 2013	July 2013	June 2013	July 2013	July 2013
27	Rochester (ROC)	Complete	Complete	February 2013	July 2013	July 2013
28	Boston (A90)	April 2013	July 2013	July 2013	August 2013	September 2013
29	Providence (PVD)	April 2013	July 2013	July 2013	FY2014	FY2014

STARS

**Due to PRM-A integration*

As of 1/23/2013



FY13 Surface Advisory Sites (15 Sites)

	Site	SBS Infrastructure Complete	Pilot Advisory Services	ASDE-X Upgrade	ATC Services Operational
1	Houston Intercontinental (IAH)	Complete	January 2013*	Complete	January 2013*
2	Atlanta (ATL)	Complete	February 2013	Complete	February 2013
3	Milwaukee (MKE)	Complete	February 2013	February 2013	February 2013
4	Denver (DEN)	Complete	Complete	February 2013	March 2013
5	Baltimore-Washington (BWI)	Complete	April 2013	Complete	April 2013
6	Detroit Wayne County (DTW)	April 2013	April 2013	March 2013	April 2013
7	Chicago Midway (MDW)	April 2013	April 2013	April 2013	June 2013
8	Los Angeles (LAX)	Complete	Complete	June 2013	July 2013
9	John F Kennedy (JFK)	May 2013	June 2013	June 2013	July 2013
10	Providence (PVD)	February 2013	August 2013	May 2013	August 2013
11	Bradley International (BDL)	February 2013	August 2013	June 2013	August 2013
12	Memphis (MEM)	Complete	June 2013	May 2013	August 2013
13	Chicago O'Hare (ORD)	May 2013	July 2013	June 2013	August 2013
14	Washington Dulles (IAD)	June 2013	July 2013	July 2013	August 2013
15	Minneapolis – St. Paul (MSP)	June 2013	September 2013	June 2013	September 2013

**will be missed*



FAA Funded Avionics Upgrades



- ADS-B Out
- Aircraft: 35 A320
- STC approved July 2012
- All 35 modifications complete ✓

- ADS-B Out and In
- Aircraft: 12 747
- STC approved June 2011
- 12 ADS-B In equipped; Upgrades to DO-260B in 2014

- ADS-B Out
- Aircraft: 110 737NG
- Boeing Service Bulletin expected Apr 2014
- Upgrades to DO-260B complete by December 2017

- ADS-B Out and In
- Aircraft: 20 A330-300/200
- STC for ADS-B Out approved August 2012; STC for Merging & Spacing approved January 2013
- 7 ADS-B Out installs complete
- Upgrades complete by October 2013

- ADS-B Out
- Aircraft: 143
 - 13 747
 - 39 767
 - 53 A300
 - 38 MD11



- STC for 767 and 747/767 AML approved (December 2011 and January 2012, respectively)
- 39 installs complete; Upgrades complete by June 2014



- ADS-B Out
- Aircraft: 54 helicopters (9 Chevron and 45 PHI)
- STC for Chevron approved June 2012; Approval expected February 2013 for PHI
- Upgrades to complete by 2015

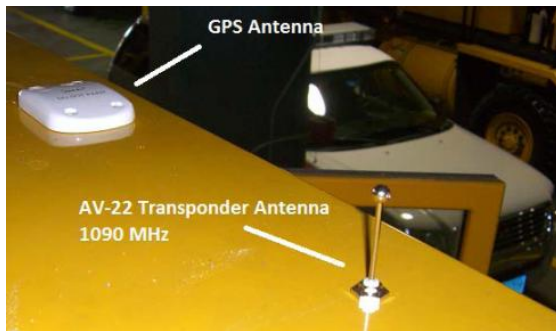


- ADS-B Out
- Aircraft: Up to 400 legacy Capstone aircraft
- Request for Offer released September 2012 and contract award in spring 2013
- Upgrades targeted for completion by December 2014



Vehicle ADS-B Summary

- June 2011 – Development of MOA partnership with Massport
- November 2011 – First article Vehicle ADS-B unit delivered to FAA for performance testing at WJHTC
- May 2012 – Production unit FAA testing completed
- September 2012 – AC updated with approved unit
- September 2012 – \$1.2M in AIP grants for Chicago, Denver, and San Francisco for Vehicle ADS-B units
- December 2012 – Completion of 37 total installations at BOS
- February 2013 (planned) – Testing of mod to continue transmission with loss of GPS at Boston
- Sites Pending – St. Louis and Milwaukee



In Process

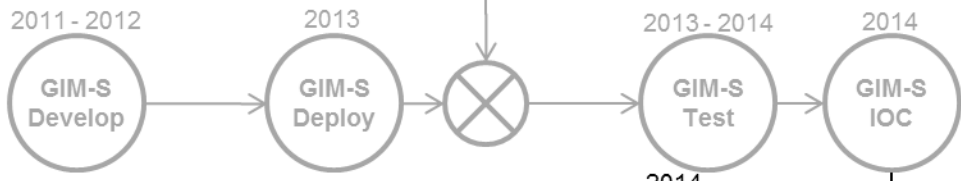
Complete

ATC Separation Services / ATC Advisory Services

Rule-Driven
ADS-B Out
Avionics Equipage
446

ATC Spacing Services

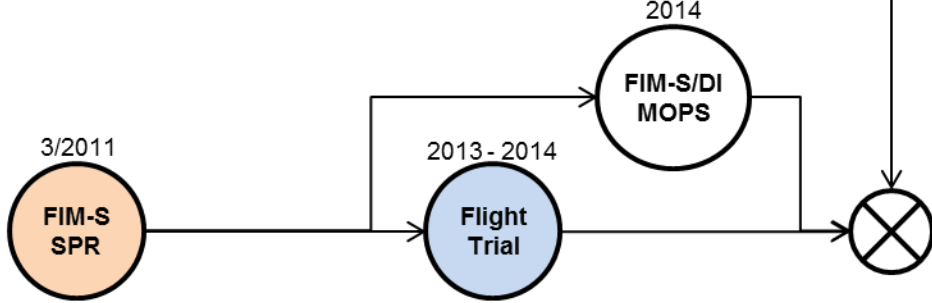
Ground-Based Interval Mgmt - Spacing (GIM-S) (En Route only)



2020
Avionics Equipage

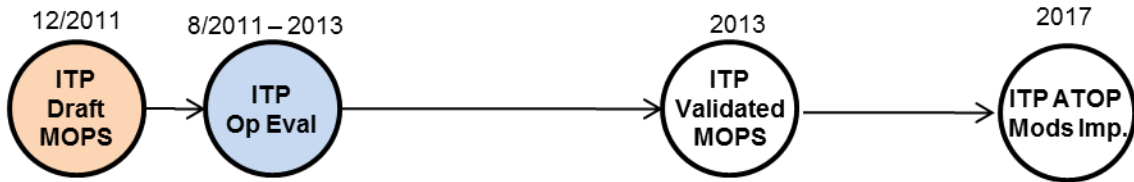
Pilot Applications

Flight Deck Based Interval Mgmt - Spacing (FIM-S)



ADS-B In
Avionics Equipage
1033

In Trail Procedures (ITP)



Traffic Situation Awareness with Alerts (TSAA)



TIS-B
FIS-B
ADS-R

Pilot Advisory Services

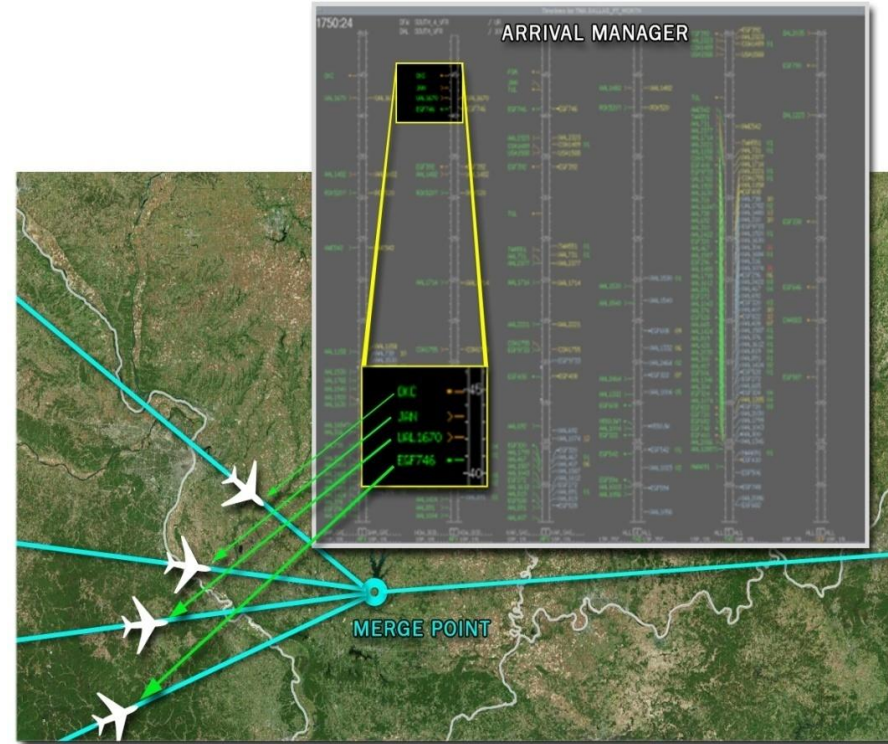
Ground-Based Interval Management - Spacing

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

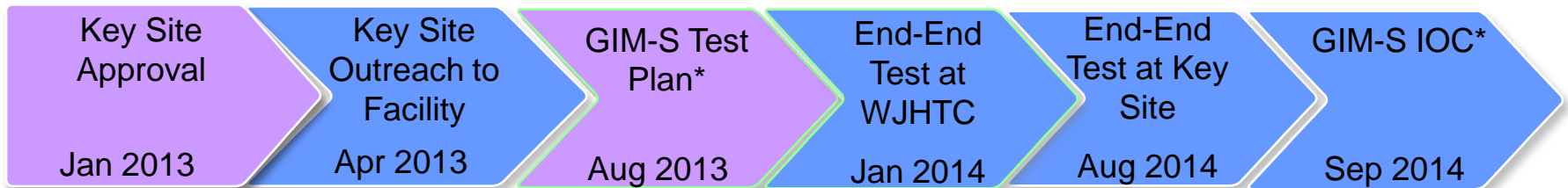
Goal: Achieve optimal spacing intervals between arriving aircraft using an ATC based spacing/metering tool

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

Partners: TBFM, ERAM, ATO-T Safety and Operations and ATO-E Safety and Operations



■ Complete ■ Not Yet Started
■ In Progress * Activity Target



Flight-deck-based Interval Management (FIM)

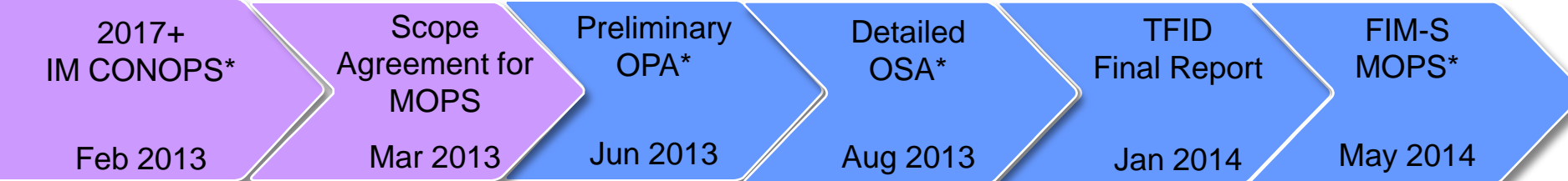
Purpose: Reduce fuel burn, noise and emissions, while maintaining high throughput and efficient flight operations throughout the NAS

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

Objective: Produce a FIM MOPS



Partners – AIR, AFS, RTCA, EUROCAE



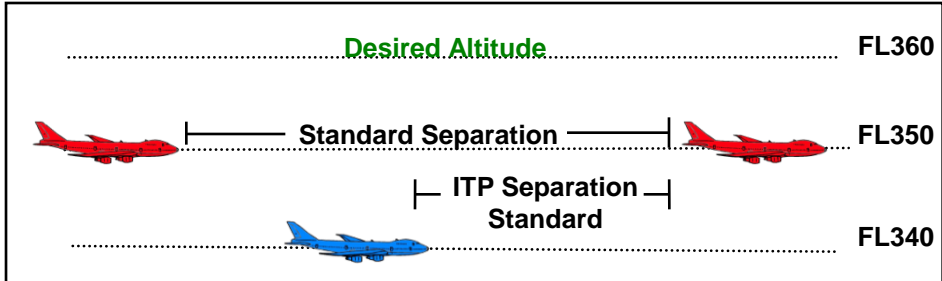
In-Trail Procedures

Purpose: Provide operational benefits in non-surveillance airspace by enabling “in-trail” climbs/descents at reduced separation distances

Goal: Employ ITP in oceanic air carrier operations (revenue service)

Objectives: Validate operational performance and economic benefits of ITP
Develop and validate ADS-B ITP MOPS material

Partners: United Airlines,
Honeywell, Goodrich,
Airservices Australia,
Airways Corp NZ



■ Complete ■ Not Yet Started
■ In Progress

ITP OpEval Results – Year 1 Completed August 2012	Begin 2 nd Year ITP OpEval Sept 2012	ITP OpEval Results – Year 1.5 March 2013	Complete 2 nd Year ITP OpEval August 2013	ATOP ITP Modifications Completed TBD 2015	ATOP ITP Modifications Implemented TBD 2016
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ITP Operational Evaluation Metrics

January 2013

Application Validation Metric	Southern Pacific		Northern Pacific		Totals
	Expected Measurement	Actual Measurement	Expected Measurement	Actual Measurement	8/12 - 1/13
Number of trained and approved pilots (747 subfleet)	598 (Expected) /171 (Actual)				171
Number of ITP capable flights (ITP aircraft, pilot and airspace)	60	18	120	23	168
Number of ITP requests	2	0	30	2	19
Number of ITP maneuvers performed	1	0	3	1	9
Number of "standard" flight level changes resulting from an ITP request	1	0	24	0	7

* Any CDPs are included in standard climbs

Safety measurements

Parameter to be Monitored	Expected Avg. Measurement	Actual Measurements			Measurements (8/12 - 1/13)		
		Min	Mean	Max	Min	Mean	Max
ITP Initiation Distance	20 nm	49.1	49.1	49.1	19.1	34.2	59.1
ITP Distance at Co-altitude	18 nm	48.8	48.8	48.8	20.2	34.4	59.7
Time From ITP Initiation to Level Off at New	7 min	4	4	4	2.0	3.9	6.0
Percentage of ITP maneuvers where a wake encounter occurred and a wake turbulence incident	2% *						
Wake Turbulence Incident Severity (5-1)**	5						

** 5 is minimal, 1 is catastrophic



Traffic Situation Awareness with Alerts (TSAA)

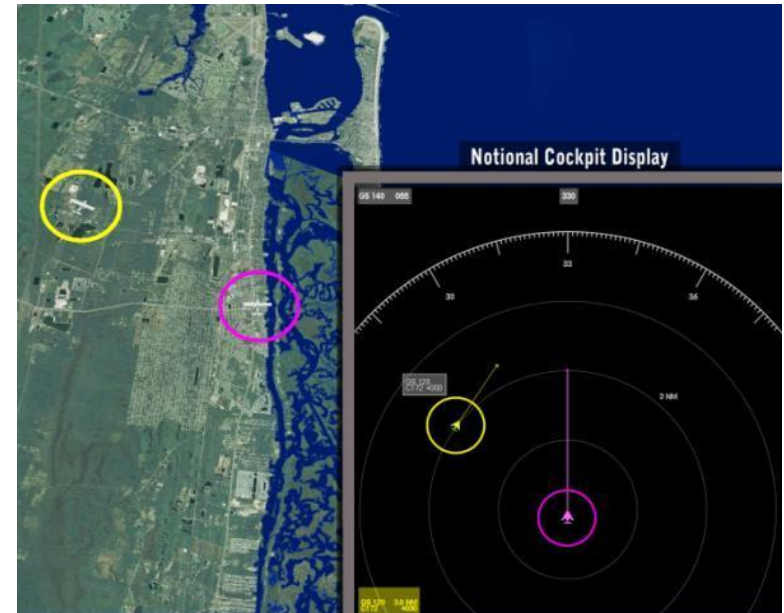
Purpose: Enhance safety in the National Airspace System by providing alerts to General Aviation pilots of conflicting airborne traffic

Goals: Reduce the risk of airborne aircraft-to-aircraft encounters
Expand ADS-B benefits for General Aviation

Objective: MOPS, TSO

Partners: MIT/Avidyne

Stakeholders: AOPA, GAMA, HAI, ALPA



ADS-B-In Aviation Rulemaking Committee

First meeting held July 1, 2010

Member Affiliation



Requested Deliverables:

- **Task 1:** Endorsement (or not) of continued work on 3 ADS-B-In application standards development projects
 → *by October 2010*
- **Task 2:** Final ARC ADS-B-In Strategy Recommendations
 → *by September 2011*
Released to Public on 9-Nov-2011
- **Task 3:** Complete all follow on work
 → *by June 2012*



U.S. Public Law 112-95, section 211(b)

(February 14, 2012)

- **Requirement:** Directs Administrator to initiate rulemaking proceeding within 1 year after enactment to issue guidelines & regulations relating to ADS-B In
- **Rulemaking scope:** by 2020, all aircraft operating in one of below to be equipped with ADS-B In technology
 - in capacity constrained airspace
 - at capacity constrained airports
 - or in any other airspace deemed appropriate
- **Before issuing a final rule, Chief NextGen Officer must verify**
 - necessary ground infrastructure is functioning properly
 - certification standards are approved
 - appropriate operational platforms interface safely and efficiently



Modified Approach

- **Revised ADS-B-In ARC Tasking (May 2012)**

- By October 31, 2012, submit recommendations on how to frame an ADS-B In equipage mandate such that benefits exceed costs before 2035
- ARC asked to identify:
 - In what airspace, and/or
 - At what airports, and/or
 - Other criteria FAA could apply to frame an ADS-B-In mandate (examples including by operator class or aircraft class)
- ARC requested to provide feedback on 2020 compliance date

- **FAA Strategy to “Initiate Rulemaking”**

- Application for Rulemaking
 - Submitted to the Rulemaking Management Council (RMC) on August 14, 2012
 - Approved by RMC on September 11, 2012
- Rulemaking Action Plan (RAP)
 - Draft prepared and under FAA management review



Status: ADS-B-In Aviation Rulemaking Committee

Member Affiliation



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