



ICAO

International Civil Aviation Organization
North American, Central American and Caribbean Office

INFORMATION PAPER

ADS-B/IMP — IP/04
22/04/15

Automatic dependent surveillance – broadcast (ADS-B) Implementation Meeting (ADS-B/IMP)

Mexico City, Mexico, 27-29 April 2015

Agenda Item 2: Review and Update on ADS-B Activities by States
2.1 Implementation status and Regional ADS-B Plan

STATUS OF ADS-B EQUIPAGE IN THE UNITED STATES

(Presented by United States)

EXECUTIVE SUMMARY

This paper presents an update on United States ADS-B equipped aircraft along with pertinent installation/configuration issues.

<i>Strategic Objectives:</i>	<ul style="list-style-type: none">• Safety• Equipage
------------------------------	-----------------------------------------------------------------------------

1. Introduction

1.1 This paper refers to a presentation providing a summary of the number of aircraft in U.S. Airspace identified as being equipped with DO-260B or DO-282B ADS-B Out equipment. Furthermore, the paper outlines a number of installation issues identified with ADS-B installations which may be of interest to this meeting.

2. ADS-B Out Avionics Equipage and Installation Issues

2.1 This paper refers to the presentation (**Appendix** to this information paper) titled ADS-B Out Avionics Equipage & Installation Issues. The information contained in the presentation provides an overview of the number of aircraft that have currently been identified in U.S. Airspace as being ADS-B Out DO-260B or DO-282B equipped. There currently exist a number of installation and configuration issues that have been identified by the Federal Aviation Administration (FAA) with these installations. The presentation provides an overview of those issues as well as the mitigation steps that are being taken by the FAA to correct the problems.

3. Conclusion

3.1 The meeting is invited to note the information contained in this paper; and discuss any relevant matters as appropriate.



**Federal Aviation
Administration**

ADS-B Out Avionics Equipage & Installation Issues

Presented to: ADS-B Task Force

Presented by: Alex Rodriguez (AIR-132)

Date: April 27-29, 2015



Agenda

- **Equipage Update**
- **STC/TC Approvals**
- **ADS-B Compliance Monitor**
- **Common Installation Issues**
- **Corrective Actions**



Equipage Monitoring

(11,052 as of Apr 5th, 2015)

Category	Feb 2015 (as of Mar 1 st , 2015)	Mar 2015 (as of Apr 1 st , 2015)	Increase	
Link Ver 2	10,211	10,949	+738	7.2%
1090ES	7,143	7,692	+549	7.7%
UAT	2,728	2,913	+185	6.8%
Dual	340	344	+4	1.2%
US General Aviation	8,811	9,443	+632	7.2%
US Air Carrier	267	276	+9	3.4%
Intl General Aviation	1,039*	1,110*	+71	6.8%
Intl Air Carrier	94	96	+2	2.1%
U.S. Military & U.S. Reserved	24	24	0	0.0%

Data Source: www.compliancemonitor.faa.gov

*Aircraft incorrectly reporting outside US ICAO block are included in Intl GA count.

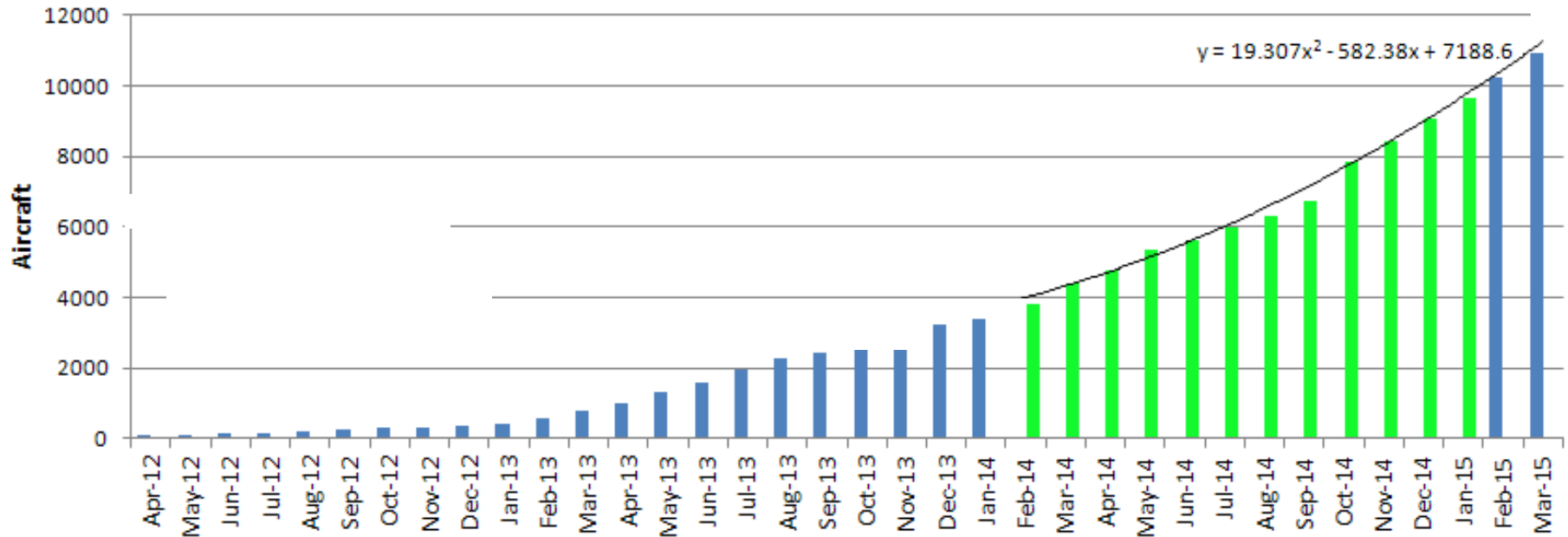


ADS-B Link Version 2 Equipage - Historical Data

April 2012 - March 2015

Curve Based on Feb '14 - Jan '15 data

Projected to 11,245 by end of Mar '15
Actual 10,949 (-296)



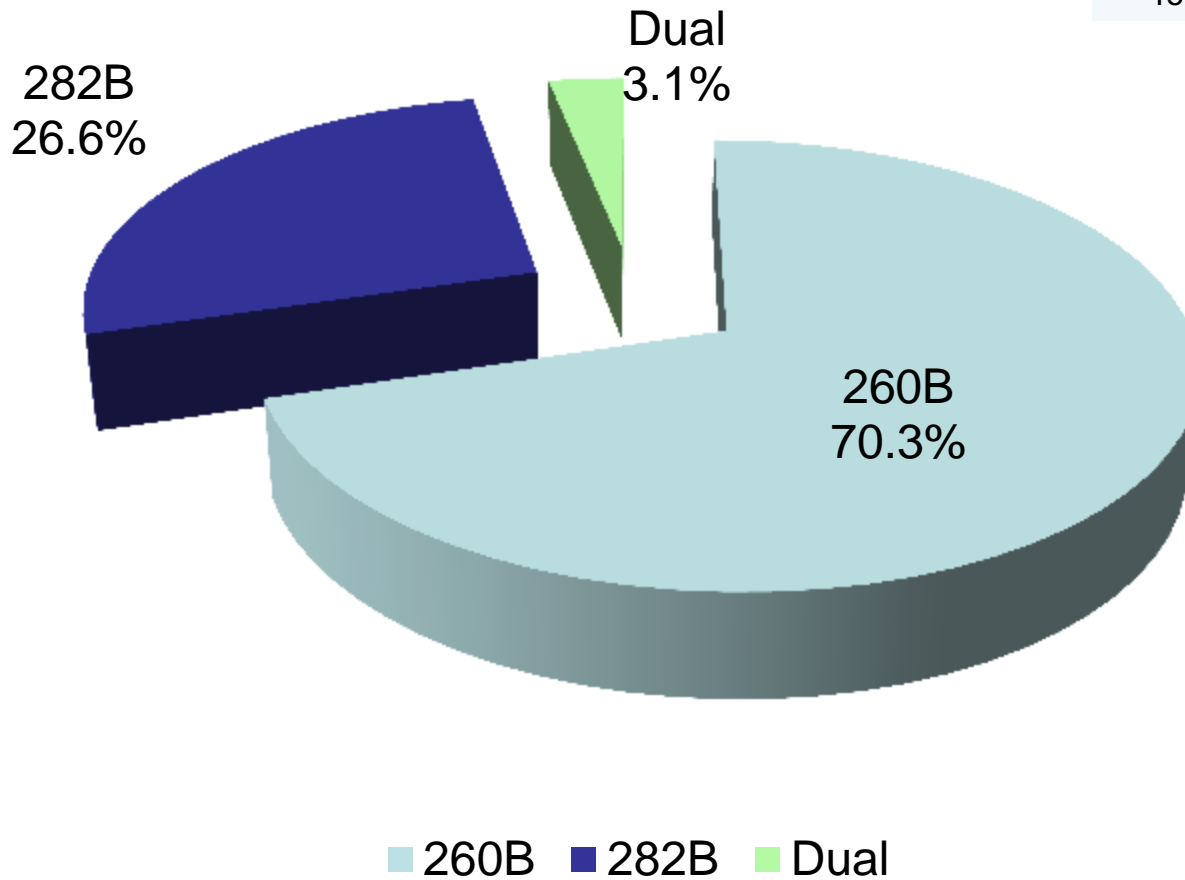
Date	Projected Equipage (based on 12-month equation above)
Jan 1 st , 2016	20,078
Jan 1 st , 2017	36,721
Jan 1 st , 2018	58,925
Jan 1 st , 2019	86,689
Jan 1 st , 2020	120,014

Projected to 12,072 by end of Apr '15



Equipage Monitoring ADS-B Out by Link

Link Type	Count
260B	7,692
282B	2,913
Dual B	344
Total	10,949



CONUS ADS-B V2 + V1 Approved GoMex Helicopters: 24 Hour Snapshot (Tues Mar 10th, 2015) Suitable for ATC automation

<https://vimeo.com/122279220>



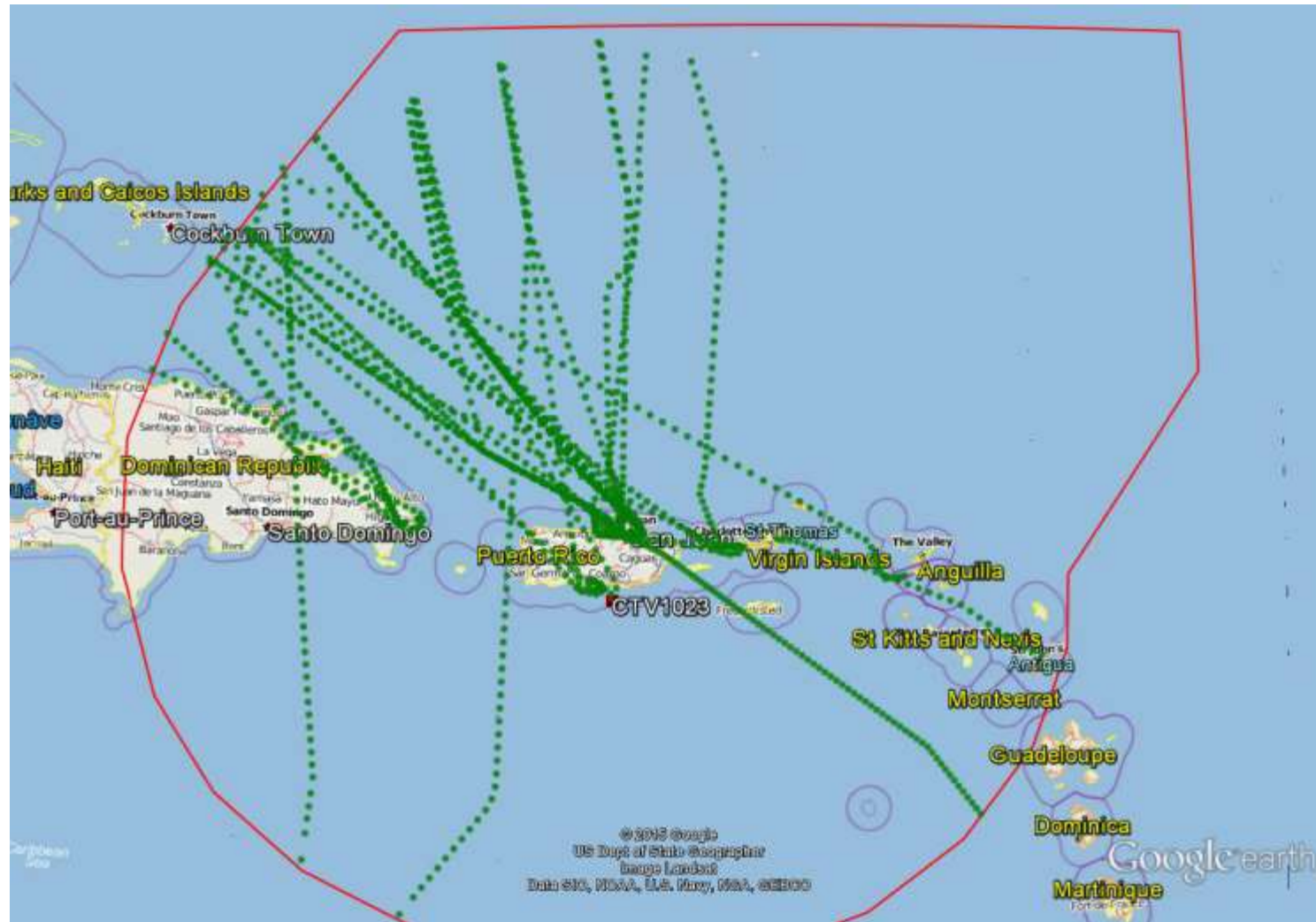
Count	Link
852	260B
235	282B
16	Dual Out
7	260A Helos
0	Anonymous Ops (Included in 282B count)
1,110	LV1+LV2

Note: Some aircraft with multiple flights

Green = DO-260B
Purple = DO-282B
Yellow = 260A
GoMex approved
helicopters

San Juan ADS-B LV2: 24 Hour Snapshot (Tues Mar 10th, 2015) Suitable for ATC automation

<https://vimeo.com/122279653>



Count	Operator or Type
10	JetBlue
2	UPS
3	US Airways
5	Business jets
20	260B

Note: Some aircraft with multiple flights

Green = DO-260B

Alaska ADS-B V2 + UAT V1: 24 Hour Snapshot (Tues Mar 10th, 2015) Suitable for ATC automation

<https://vimeo.com/122279652>

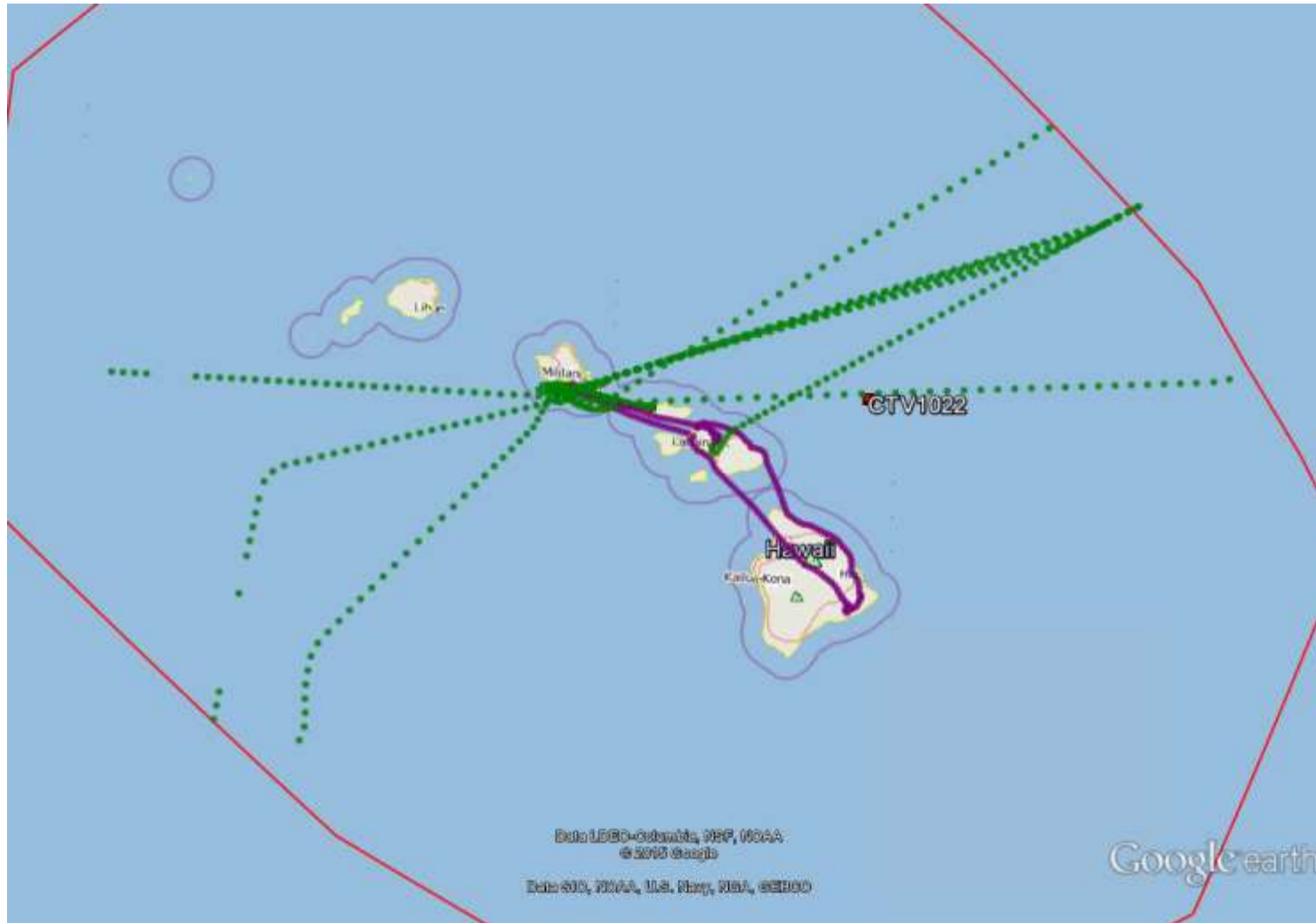
Count	Link
27	260B
52	282B
1	Dual Out
107	282A
187	LV1+LV2

Note: Some aircraft with multiple flights

Green = DO-260B
Purple = DO-282B
Blue = DO-282A UAT

Hawaii ADS-B LV2: 24 Hour Snapshot (Tues Mar 10th, 2015) Suitable for ATC automation

<https://vimeo.com/122279688>



Count	Operator or Type
4	UPS
4	Business Jets
1	UAT Piper PA-31
9	Total

Note: Some aircraft with multiple flights

Green = DO-260B
Purple = DO-282B

FAA-Approved V2 ADS-B Out Avionics, 1 of 4

as of 03-Apr-2015

* multiple STC dates; only earliest shown

Surveillance Manufacturer	Model #	Approved Position Source(s)	Aircraft	Approval Date	AML Approved
Exelis / FreeFlight	FDL-978-TXG		VEHICLE	May 2012	Massport
ACSS	XS-950	RCI GLU-920 , GLU-925 RCI GLU-920 Thales TLS8755-01-0101A/0102B RCI GPS-4000S	767, 747, A300, MD11 A320 A330 757	STC Jan 2012* STC Jul 2012 STC Aug 2012 STC Jul 2014	Yes No No No
Honeywell	XS-852	CMC CMA-4024-1 SBAS	Embraer 145, Learjet 45, Hawker 800, and Citation X	Jan 2012	No
Trig-Avionics	TT-31	FreeFlight WAAS 1201 Accord Technology NexNav™ Mini Garmin GNS 400W/500W series Trig TN70	Mooney M20B-M20G, M20J & M20K	STC May 2012*	Yes
FreeFlight	FDL-978-TX	FreeFlight WAAS 1201	Agusta Westland 139 Cessna 172S	STC Jun 2012*	No Yes
Honeywell	ISP-80A.1	Honeywell ADIRU Part#s HG2030BE02, BE03 or BE04	A380	EASA TC Jul 2012	Yes via Production
Trig-Avionics	TT-22	FreeFlight WAAS 1201	King Air C-90A, Aviat/Pitts (aerobatic) S-76A/B/C (all variants)	STC Nov 2012*	No (King Air) Yes (Pitts) No (S-76x)



FAA-Approved V2 ADS-B Out Avionics, 2 of 4

as of 03-Apr-2015

* multiple dates; only earliest shown

Surveillance Manufacturer	Model #	Approved Position Source(s)	Aircraft	Approval Date	AML Approved
Garmin	GDL-88 GTX-23 GTX-33x w/ES GTX-330x GTX-3000 (GTX models require appropriate S/W rev)	Garmin GTN 625/635/650, GTN 725/750, GPS 400W, GNC 420W/420AW, GNS 430W/430AW, GPS 500W/530W (w/ or w/o TAWS) (all require appropriate S/W rev)	King Air C-90	STC Dec 2012*	Yes
			Multiple Gulfstream models^	TC amendment Dec 2014	Yes via Production or Aircraft Service Change (ASC)
Honeywell	MRC XPDR w/ADS-B Out	CMC CMA-3024 SBAS GNSSU MK II and CMA-4024 SBAS GNSSU	Agusta Westland 139	EASA TC Feb 2013	Yes via Production
Honeywell	XS-858B P/N 7517402-970	Honeywell GPS module (made by CMC), P/N 245-604067-100	Gulfstream 450/550	TC amendment Feb 2013	Yes via Production or ASC
Honeywell	XS-858B P/N:7017401-970	CMC GNSS/MMR, P/N 245-604067-100 Honeywell GNSS/MMR VIDL-G, P/N: 7026208-804	Falcon 2000EX/S, F900X	Mar 2013*	No
			Falcon F7X	Apr 2013	No
FreeFlight	FDL-1090-TX	FreeFlight WAAS 1201 (either external or integrated in FDL-978-XVR)	King Air C-90	STC Apr 2013	No

^ these are "dual out" installations (ADS-B Out on both UAT and 1090) of GDL-88 and GTX-330/3000



FAA-Approved V2 ADS-B Out Avionics, 3 of 4

as of 03-Apr-2015

* multiple dates; only earliest shown

Surveillance Manufacturer	Model #	Approved Position Source(s)	Aircraft	Approval Date	AML Approved
FreeFlight	FDL-978-XVR	FreeFlight WAAS 1201 (either external or integrated in FDL-978-XVR)	Bell-206	STC Feb 2014*	No
			Fixed Wing		Yes
Avidyne	AXP340	N/A	N/A	Feb 2014	No
Rockwell	TDR-94/94D-550/551	Universal UNS-1Fw	S-92A	TC Feb 2014	Yes via Production
			S-76C, S-92A	STC Mar 2014*	No
BendixKing	KT-74	Accord Technology NexNav™ Mini FreeFlight WAAS 1201 GNS 400W/500W series	M20C	STC Mar 2014	Yes
Honeywell	KXP 2290A	Honeywell KGS200	PC-12/47E	EASA TC Apr 2014	Yes via Production
NavWorx	ADS600-B	Accord Technology NexNav™ Mini	Piper PA-32RT	STC Jun 2014	Yes
Rockwell	TSS-4100	RCI GPS-4000S	G280	Apr 2015	Yes via Production
ACSS	NXT-600	Universal UNS-1Fw, UNS-1Lw, UNS-1Ew, UNS-1Espw; Thales Topstar 200 LPV or NG	Q400	TC TC Jul 2014	Yes via Production
			ATR 42/72-600	EASA TC Mar 2015	Yes via Production

Note: "N/A" indicates equipment has received TSOA, but has not received any other certification



FAA-Approved V2 ADS-B Out Avionics, 4 of 4

as of 03-Apr-2015

** multiple dates; only earliest shown*

Surveillance Manufacturer	Model #	Approved Position Source(s)	Aircraft	Approval Date	AML Approved
ACSS	NXT-800	RCI GLU-925 RCI GLU-920/925	767 757, 767	TC Nov 2014 STC Mar 2015	Yes via Production Yes
Garmin	GTX-330ES	Garmin GNS-430W	AS350	Dec 2014	No
L-3 Aviation Products	NGT-2000/2500 NGT-9000D	Integrated in NGT-xxxx (SBAS)	Cirrus SR-22 Cirrus SR-22	Jan 2015 Mar 2015	Yes Yes
Rockwell	TDR-94/94D-501	RCI GPS-4000S	Beechjet 400A	Feb 2015	Yes
Aspen Avionics	ATX100G	FreeFlight WAAS 1201 (integrated in ATX100G)	N/A	Mar 2015	N/A

Note: "N/A" indicates equipment has received TSOA, but has not received any other certification



FAA-Sponsored Projects that will result in Version 2 ADS-B Out Avionics

Surveillance Manufacturer	Model #	Planned Position Source(s)	Aircraft	Planned STC Availability	Operator
FreeFlight	FDL-978-XVR	FreeFlight WAAS 1201 (either external or integrated in FDL-978-XVR)	Rotorcraft models other than Bell 206	Mid-2015	Approximately 40 rotorcraft in Alaska
Rockwell	TPR 901-205	RCI GLU 925-001 RCI GLU 925-330	737-700/800/900 (aka "737NG")	Boeing Service Bulletin Q1 2016*	United

Boeing provided UAL with a Service Bulletin to wire 737NG for ADS-B Version 2 in 2013; UAL has wired 61 aircraft as of 28-Feb-2015

All Boeing production aircraft have wiring provisions installed for ADS-B Version 2 as follows:
 737NGs beginning with Line Number 4522 (YS115, 03-Jun-2013)
 747-8 beginning with Line Number 1490 (RC510, 07-Oct-2013)
 767 beginning with Line Number 1063 (VT558, 10-Oct-2013)
 777 beginning with Line Number 1132 (WE166, 01-Aug-2013)

FAA-Approved Version 2 ADS-B In Avionics

as of 03-Apr-2015

* multiple dates; only earliest shown

Manufacturer	Model #	Aircraft	STC Date	AML Approved
Honeywell	TPA-100B	B747-400	June 2011	No
Honeywell	TPA-100B	A330/340 A318/319/320/321	Dec 2011**	Yes via Production
ACSS	TCAS3000SP	A330/340 A318/319/320/321	Dec 2011**	Yes via Production
ACSS	TCAS3000SP	B767-300, A330	May 2012*	No
Garmin	GDL-88	King Air C-90	Dec 2012	Yes
NavWorx	ADS600-B	Piper PA-32RT	Jun 2014	No
FreeFlight	FDL-978-XVR	Bell 206 Fixed Wing	Feb 2014*	No Yes
L-3 Aviation Products	NGT-2000/2500 NGT-9000	Cirrus SR-22 ?	Jan 2015 Mar 2015	Yes Yes
Aspen Avionics	ATX100G	N/A	Mar 2015	N/A

Note: "N/A" indicates equipment has received TSOA, but has not received any other certification

**Airbus ATSAW (with and without ITP) received EASA approval in May 2011 as TC amendment; all A330/340s produced since Jan 2011 and all Airbus single-aisle aircraft produced since mid-2011 are ATSAW/ITP-capable



FAA-Sponsored Projects that will result in Version 2 ADS-B In Avionics

Manufacturer	Model #	Aircraft	Planned STC Availability	Operator
FreeFlight	FDL-978-XVR	Rotorcraft models other than Bell 206	Mid-2015	Approximately 40 rotorcraft in Alaska




ADS-B Compliance Monitor

- **Primary purpose**
 - Support FAA Flight Standards with compliance & enforcement of 14 CFR §91.225 and §91.227
 - Monitor & record all ADS-B Out aircraft operations in the NAS & generate reports based on compliance of §91.227 requirements
- **Secondary purpose**
 - Support installation testing
 - Support aircraft certification test flight process for new approvals
 - Monitor ADS-B equipage and growth
 - Support avionics performance trend analysis



ADS-B Compliance Monitor

- Organizes ADS-B data into flight operations
- Generates compliance reports for all ADS-B monitored operations

 U.S. Department of Transportation
Federal Aviation Administration
ADS-B Compliance Monitor

ADS-B Aircraft Operation Compliance Report

ICAO: A5BEC0 (51937300) Tail Number: N47 Flight No: N47

Period: 05-26-2014 13:05:05 to 06-25-2014 14:03:29

Aircraft: 2005 - BOMBARDIER INC BD-700-1A11
Year - Make / Model

Non-Compliance Issues Identified

Items highlighted in red within this report indicate the ADS-B Out system installed on this aircraft failed to meet the corresponding performance requirement as specified in § 91.227. The owner/operator must take corrective action and verify ADS-B Out system performance prior to operation of this aircraft in the airspace specified in § 91.225. Requests for authorization to deviate from § 91.225 for urgent movements of the aircraft to other ADS-B Out system require verification may be made to the appropriate ATC facilities per §91.225(g).

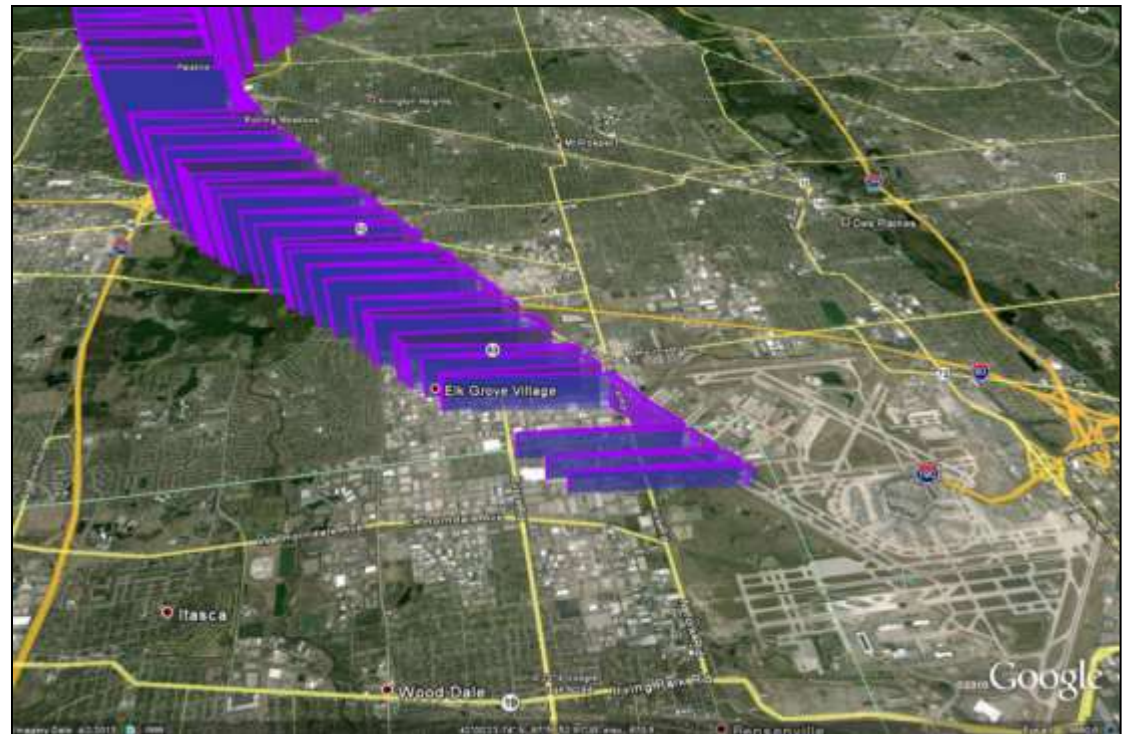
Required Message Elements Checks
 Integrity And Accuracy Checks
 Kinematics Checks
 Other Checks

Prepared For Owner of Record:
FEDERAL AVIATION ADMINISTRATION
WILLIAM J HUGHES TECHNICAL CENTER
FLIGHT PROGRAM BLDG 301 HANGAR
ATLANTIC CITY, NJ 08405-0301

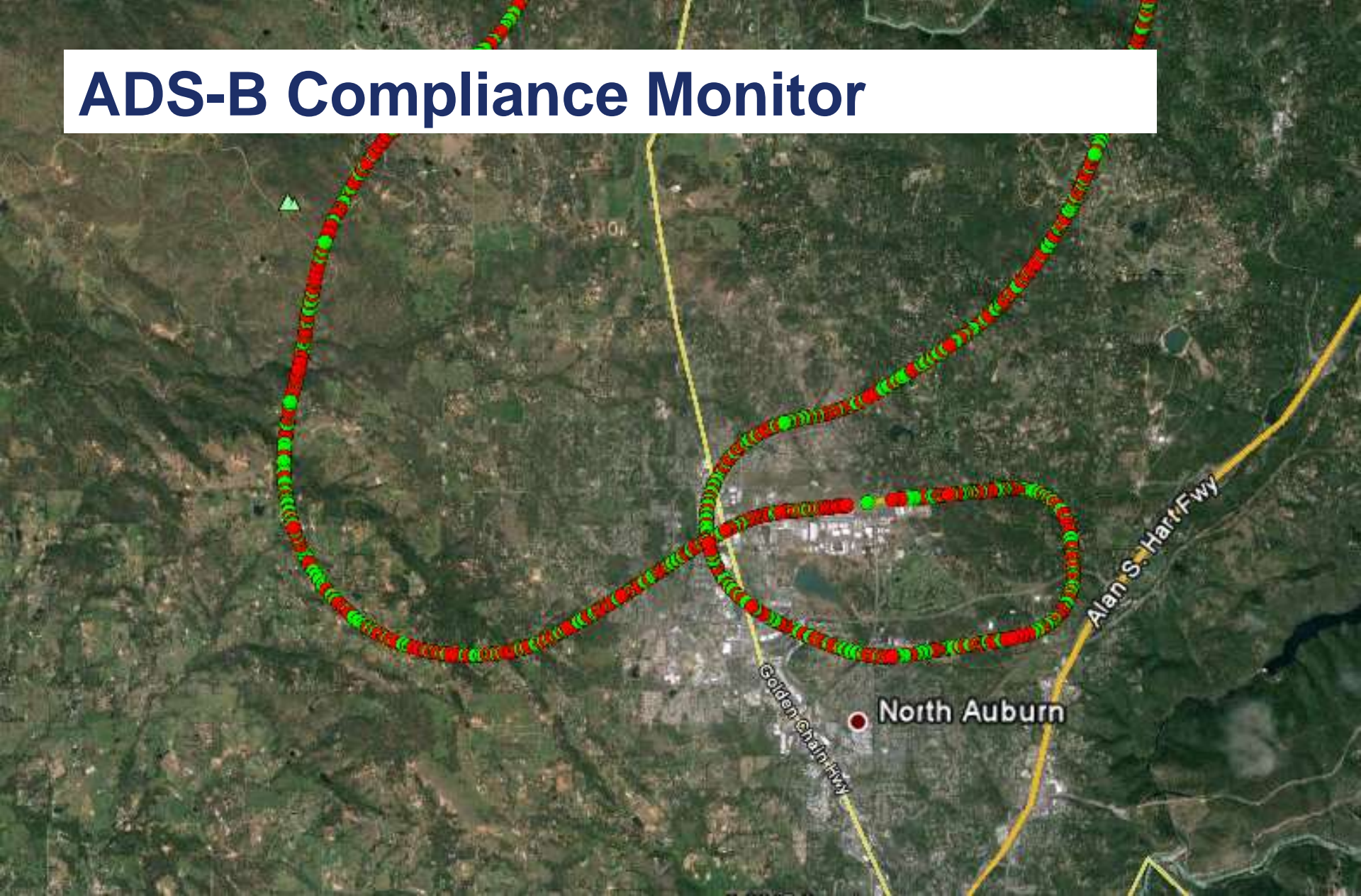
Prepared By
Surveillance and Broadcast Services (SBS) Program
ADS-B Compliance Monitor

September 11, 2014

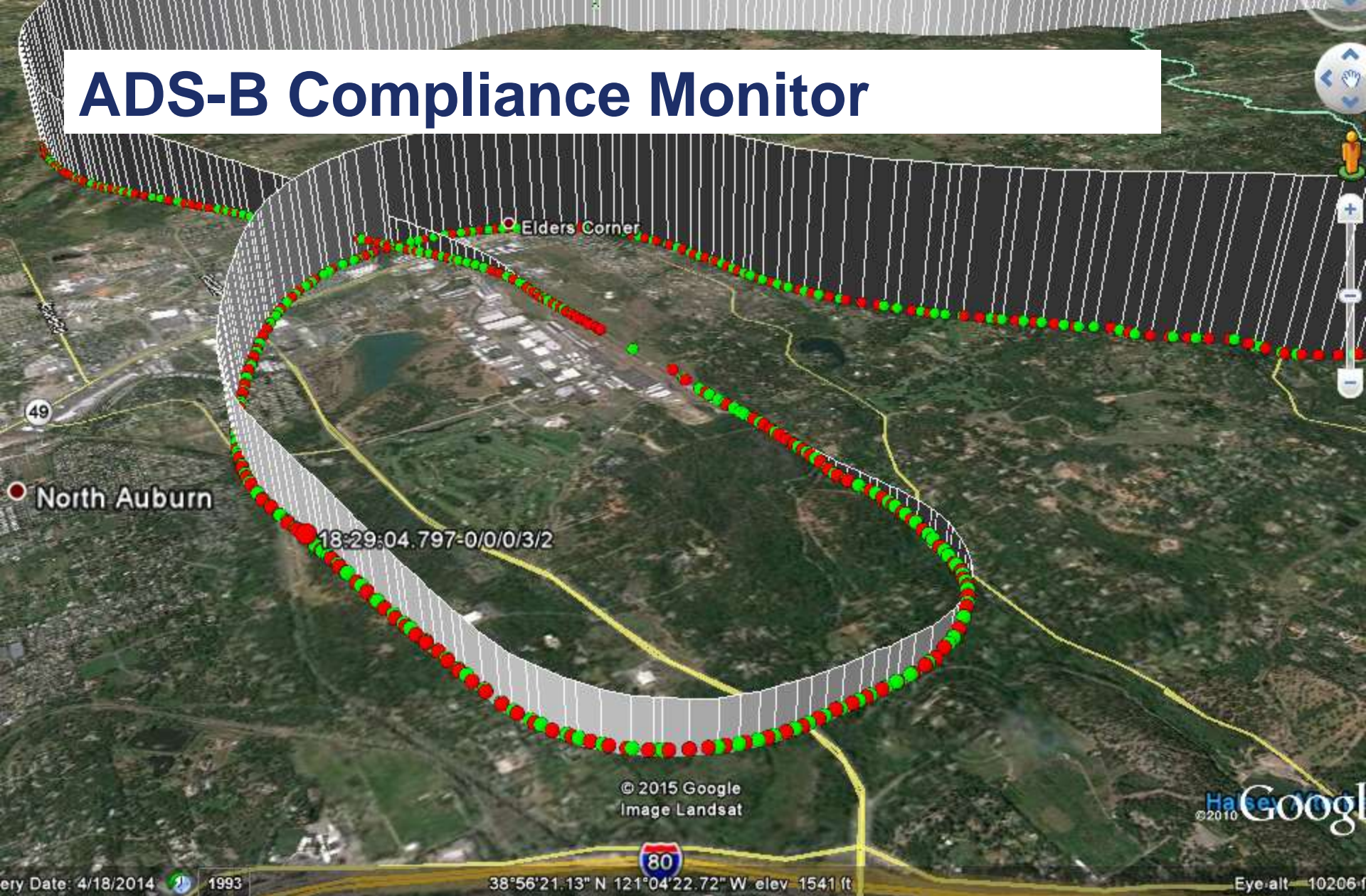
20140918_A5BEC0_2210761 Page 1 of 11



ADS-B Compliance Monitor



ADS-B Compliance Monitor

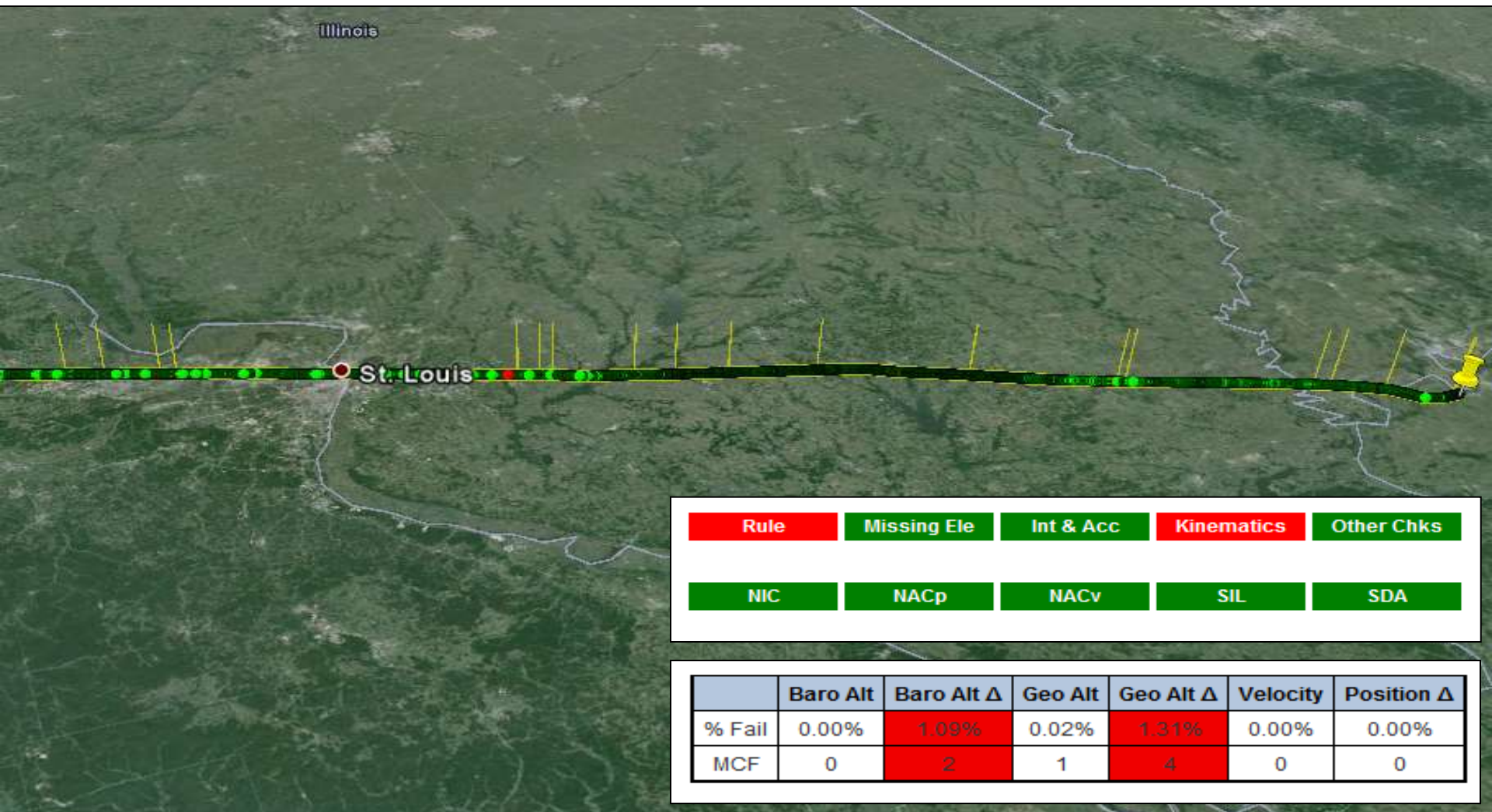


Avionics Issues

Title	Notes
Missing Barometric Pressure Altitude	42 aircraft not reporting Barometric Altitude as of March 16, 2015
Air/Ground Determination Issues	Aircraft incorrectly reporting in Air while On-Ground.
Flight ID issues including Missing Flight ID 3-letter identifier	155 flights with number-only Flight ID in last 30 days as of March 16, 2015
Duplicate & Wrong ICAOs	Aircraft reporting FFFFFF, 123456, 000000, A00000
Invalid Mode 3/A Code - Mitigation in place	78 as of 3/16/2015 58-of-78 with ops in Feb or March 2015 73 as of 2/2/2015
Incorrect Emitter Category	Approx 15% of aircraft reporting Emitter Cat = 2 should be reporting Category = 1
Aircraft with Position Errors	Position jumps can be noticed on aircraft requiring a software update to the position source.



Common Issues (Baro)



Rule	Missing Ele	Int & Acc	Kinematics	Other Chks
NIC	NACp	NACv	SIL	SDA

	Baro Alt	Baro Alt Δ	Geo Alt	Geo Alt Δ	Velocity	Position Δ
% Fail	0.00%	1.09%	0.02%	1.31%	0.00%	0.00%
MCF	0	2	1	4	0	0

Common Issues (Baro)



Duplicate ICAO address

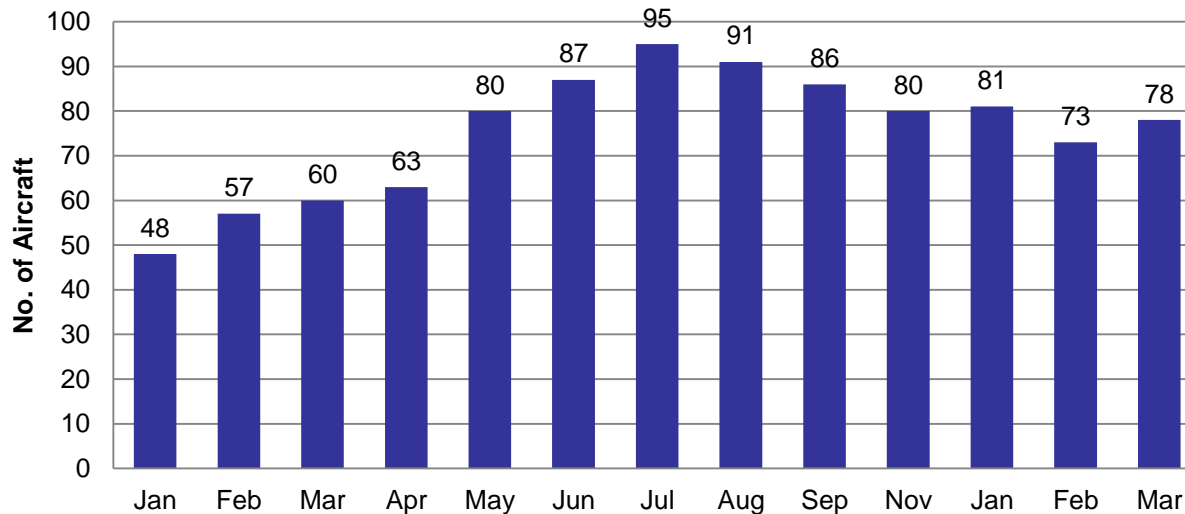


Two aircraft operating at the same time within 170NM of each other with same ICAO

Aircraft flying near Williamsport, PA is using the same ICAO belonging to another aircraft instead of the correct ICAO code

APR-007 Invalid/Missing Mode 3/A Codes

UAT LV2s Reporting Compliant NIC/NACp/NACv/SIL/SDA
Mode 3/A Flagged Invalid



2.9% of
LV2 UAT
aircraft

Notes

No Anonymous Reports

Compliant NIC/NACp/NACv/SIL/SDA \geq 99% and Valid \geq 99%

No Vehicles

At least 10,000 reports

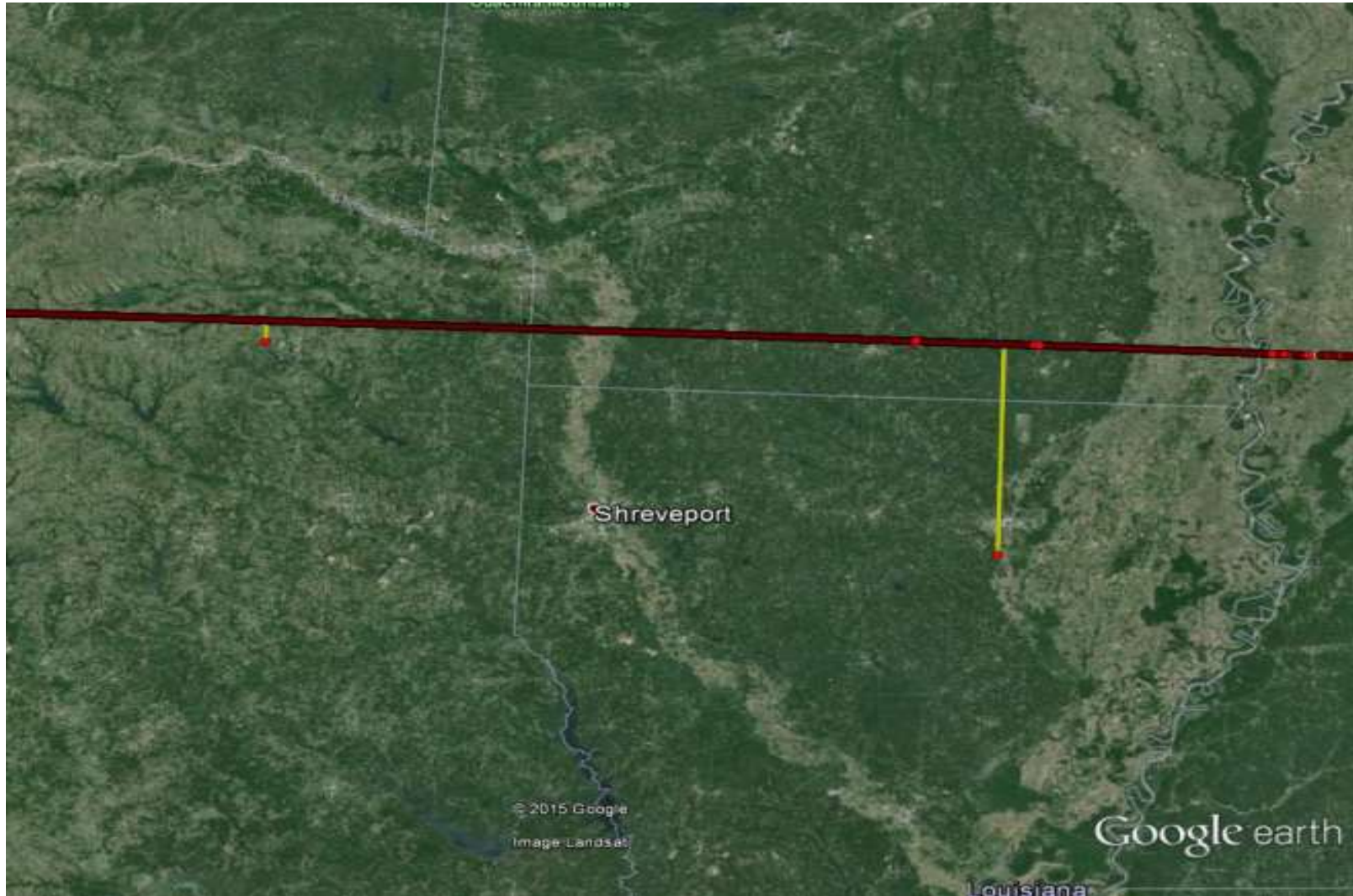
Incorrect Emitter Category

ADS-B Emitter Category SET "A"	
Coding	Meaning
0	No ADS-B Emitter Category Information
1	Light (<15500 lbs.)
2	Small (15500 to 75000 lbs.)
3	Large (75000 to 300000 lbs.)
4	High-Vortex Large (aircraft such as B-757)
5	Heavy (> 300000 lbs.)
6	High Performance (>5g acceleration and > 400 knots)
7	Rotorcraft

Emitter Category being set to incorrect values. For example:

- a) General Aviation setting Emitter value to "6".
- b) Value being set to "2" when should be a "1".

Aircraft with Position Errors



Common Installation Issues

- **Corrective Actions**

- FAA, (AIR, SBS and AFS), providing information, supporting outreach programs related to ADS-B
 - Support seminars/briefings @ trade & industry events
 - Coordination of related articles in trade & industry publications
 - <https://www.faa.gov/nextgen/implementation/programs/adsb/>
- ADS-B Avionics Check
 - 9-AWA-AFS-300-ADSB-AvionicsCheck@faa.gov
- Investigate compliance issues worked as a team effort
 - Operators and installers contacted by AFS
 - Manufacturers contacted by AIR

Corrective Actions

- **ADS-B Focus Team was created to Investigate compliance issues and work with owner/operators & industry to resolve**
 - Operators and installers contacted by AFS
 - Manufacturers contacted by AIR
- **Support outreach programs related to ADS-B**
 - Conduct seminars/briefings at trade & industry events
 - Coordinate related articles in trade & industry publications
 - Provide information on ADS-B through the NextGen website (<https://www.faa.gov/nextgen/implementation/programs/adsb>)
- **Provide ADS-B Avionics Checks**
 - Verify ADS-B installations to ensure proper compliance prior to January 1, 2020

Questions?

Alex Rodriguez

Aerospace Engineer

Systems and Equipment Standards Branch (AIR-132)

Alex.J.Rodriguez@faa.gov



CONUS ADS-B V2 + V1 Approved GoMex Helicopters: 24 Hour Snapshot (Tues Apr 14th, 2015) Suitable for ATC automation

<https://vimeo.com/125604136>

Count	Link
951	260B
313	282B
23	Dual Out
8	260A Helos
10	Anonymous Ops (Included in 282B count)
1,295	LV1+LV2

Note: Some aircraft with multiple flights

Green = DO-260B
Purple = DO-282B
Yellow = 260A
GoMex approved helicopters

San Juan ADS-B LV2: 24 Hour Snapshot (Tues Apr 14th, 2015) Suitable for ATC automation

<https://vimeo.com/125606008>



Count	Operator or Type
10	JetBlue
4	UPS
2	US Airways (next month reported as American Airlines)
1	Delta B767
6	Business jets
23	260B

Note: Some aircraft with multiple flights

Green = DO-260B