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North American, Central American and Caribbean Office

INFORMATION PAPER

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Automatic Dependent Surveillance – Broadcast OUT Implementation Meeting for the NAM/CAR Regions (ADS-B/OUT/M)

Ottawa, Canada, 21-23 August 2019

Agenda Item 2: **Update Status ADS-B Implementation for States**
2.3 ADS-B trial Statistic collection

OVERVIEW OF ADS B EQUIPAGE IN THE U.S.

(Presented by the United States)

EXECUTIVE SUMMARY	
This Information Paper presents an overview of ADS-B equipage trends and statistics as collected and analysed by the Federal Aviation Administration (FAA), as of 1-Aug-2019.	
Strategic Objectives:	• Safety • Air Navigation Capacity and Efficiency • Environmental Protection
References:	• FAA's ADS B Performance Monitor (APM)

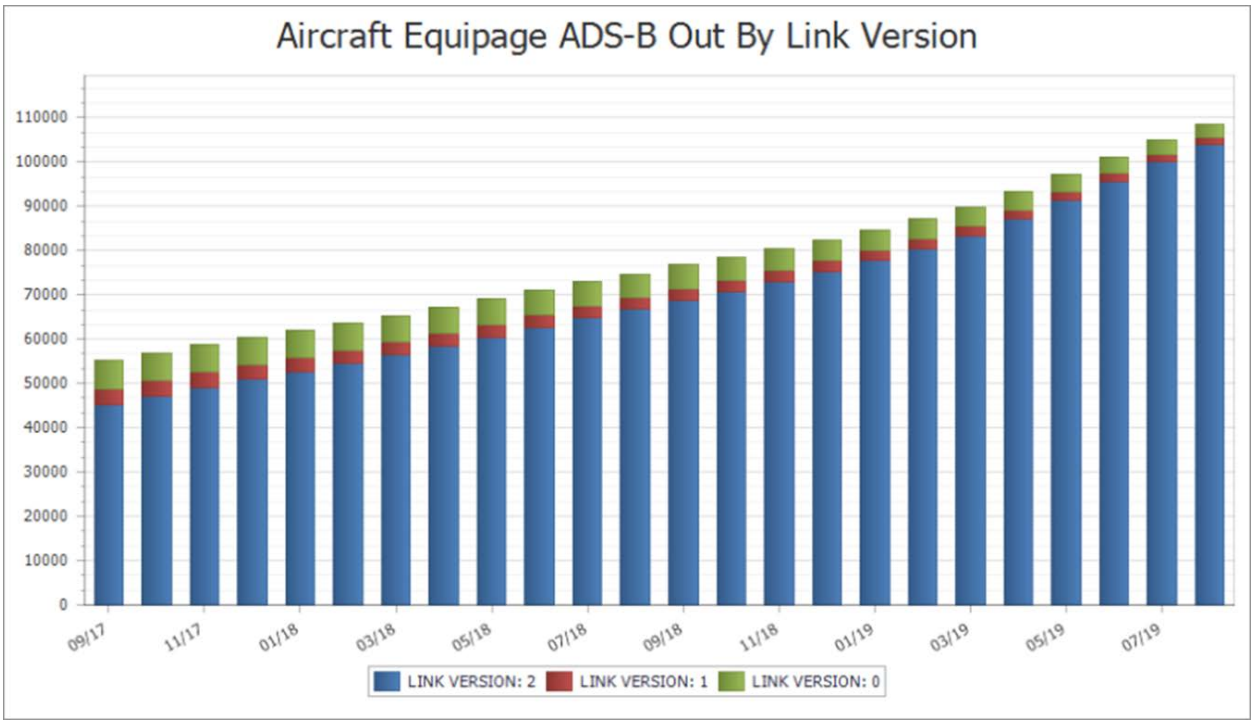
1. Introduction

1.1 The FAA's ADS B Performance Monitor (APM) is used to regularly measure the quantity of ADS B Version 2 systems installed on aircraft operating in U.S. ADS-B airspace, as well as analyzing the degree to which certain aircraft are meeting the requirements of the U.S. ADS B mandate.

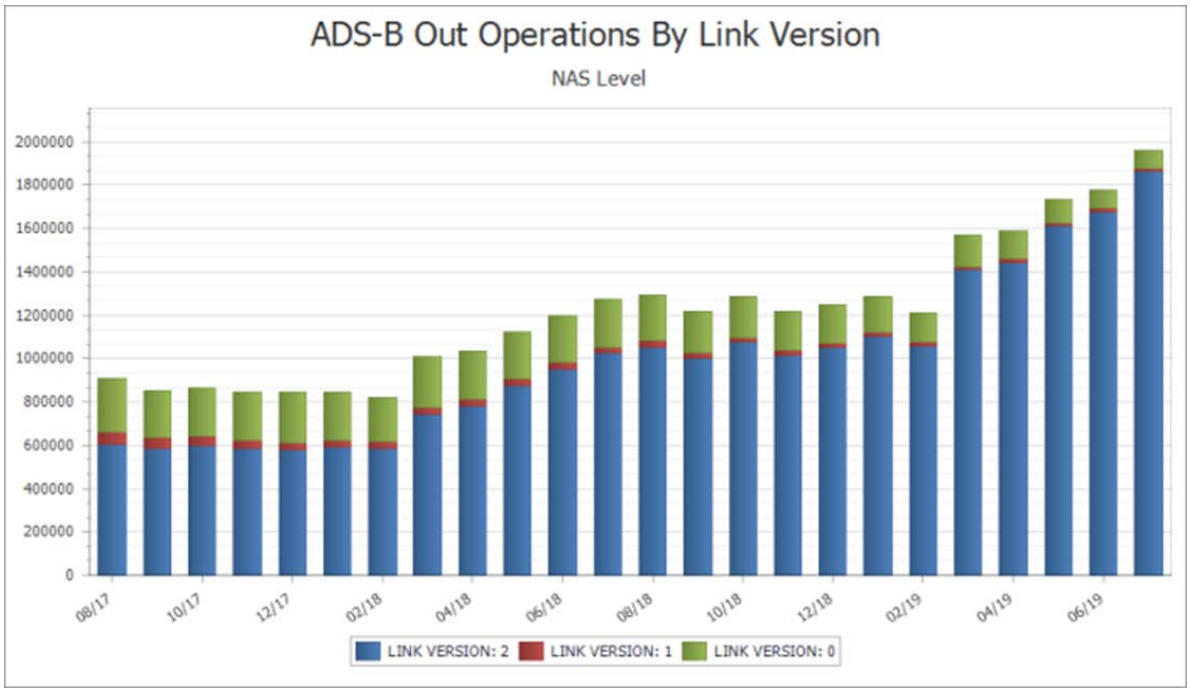
2 Discussion

2.1 Tracking ADS B equipage trends in the U.S.

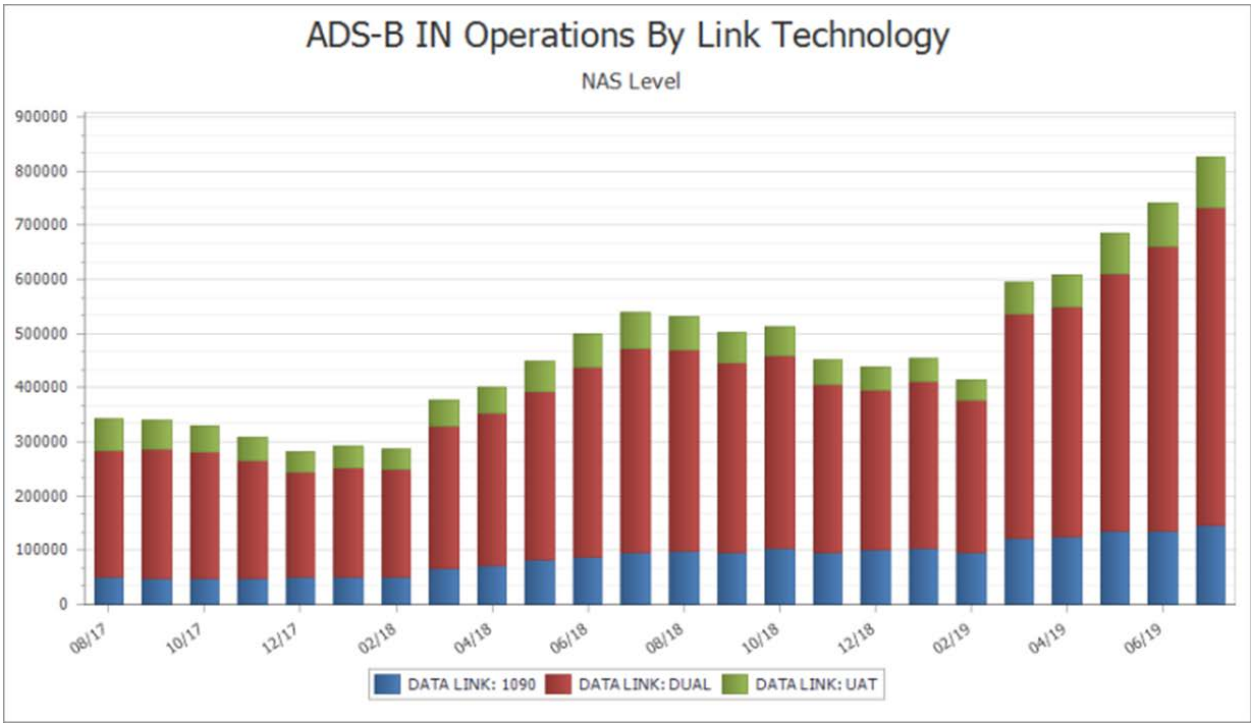
2.1.1 The FAA's APM has various capabilities for tracking ADS B equipage trends. The APM tracks unique ICAO aircraft addresses and keeps statistics over the past two years. The count of ICAO aircraft addresses is based on the detected addresses during the year prior to the count period. For example, the count of ICAO aircraft addresses in July 2018 includes all addresses detected since July 2017. If an ICAO aircraft address is not detected for over a year, it is dropped from the count in the month when that occurs. The figure below shows the number of aircraft with different ADS B versions since 1 September 2017. During this period, the number of ADS B Version 0 aircraft has decreased from 6,432 to 3,135; the number of ADS B Version 1 aircraft has decreased from 3,522 to 1,630. In contrast, ADS B Version 2 aircraft equipage has more than doubled.



2.1.2 The APM can also display equipage trends as they impact ATC operations. The figure below shows the number of operations by different ADS B versions since 31 August 2017. During this period, the number of ADS B Version 0 operations has decreased from 248,176 per month to 80,056 per month; the number of ADS B Version 1 operations has decreased from 52,076 per month to 12,144 per month. In contrast, ADS B Version 2 operations have more than tripled, crossing the 1M operations per month threshold during June 2018.



2.1.3 The APM is also capable of showing data by "link technology" – this is useful for understanding the relative fraction of UAT and 1090ES equipage in the U.S. The figure below shows the number of operations by different ADS B In link technology variations since the end of August 2017 (ADS B Out Version 2 reports most of the information shown, as ADS B Out Version 1 is incapable of reporting "Dual" In). During this period, the number of 1090ES ADS B In operations has increased from a low of 46,840 per month to 96,724 per month at the end of February 2019 (peaking at 102,614 during October 2018); the number of UAT ADS B In operations has increased from a low of 35,862 per month during February 2018 to 146,811 during July 2019. Meanwhile, the number of Dual In ADS B In operations has increased from a low of 193,916 per month during December 2017 to 585,264 during July 2019. The seasonal variations seen in this two year data sample show that most ADS B In systems are installed in small GA aircraft – these aircraft fly more often in the summer/fall than in the winter/spring.



2.2 Observed NIC/NACp performance compared to 14 CFR 91.227 requirements.

2.2.1 The FAA's APM is used to regularly analyse the degree to which ADS B Version 2 systems installed on air carrier aircraft are meeting the requirements of the U.S. ADS B mandate (the focus on air carrier aircraft is due to the fact that virtually all GA aircraft with ADS B Version 2 systems have Satellite-based Augmentation System (SBAS) position sources). The table below is the NIC performance analysis for the two year period ending 9 Aug 2019.

Radius of Containment (Rc)	NIC	2 months ending 9-Oct-2017	2 months ending 9-Dec-2017	2 months ending 9-Feb-2018	2 months ending 9-Apr-2018	2 months ending 9-Jun-2018	2 months ending 9-Aug-2018	2 months ending 9-Oct-2018	2 months ending 9-Dec-2018	2 months ending 9-Feb-2019	2 months ending 9-Apr-2019	2 months ending 9-Jun-2019	2 months ending 9-Aug-2019
Rc unknown	0	0.0052%	0.0123%	0.0100%	0.0432%	0.1165%	0.0532%	0.0160%	0.0135%	0.0112%	0.0240%	0.0134%	0.0165%
Rc < 20 nm	1	0.0000%	0.0000%	0.0000%	0.0001%	0.0001%	0.0001%	0.0001%	0.0001%	0.0002%	0.0001%	0.0004%	0.0003%
Rc < 8 nm	2	0.0000%	0.0001%	0.0001%	0.0001%	0.0002%	0.0002%	0.0002%	0.0002%	0.0002%	0.0003%	0.0005%	0.0004%
Rc < 4 nm	3	0.0000%	0.0002%	0.0001%	0.0002%	0.0003%	0.0001%	0.0002%	0.0002%	0.0001%	0.0004%	0.0005%	0.0005%
Rc < 2 nm	4	0.0001%	0.0004%	0.0003%	0.0005%	0.0006%	0.0003%	0.0005%	0.0004%	0.0003%	0.0009%	0.0007%	0.0009%
Rc < 1 nm	5	0.0003%	0.0005%	0.0004%	0.0007%	0.0011%	0.0005%	0.0009%	0.0006%	0.0006%	0.0012%	0.0009%	0.0012%
Rc < 0.6 nm	6(0)	0.0003%	0.0003%	0.0003%	0.0005%	0.0007%	0.0003%	0.0006%	0.0005%	0.0005%	0.0008%	0.0005%	0.0010%
Rc < 0.5 nm	6(1)	0.0053%	0.0052%	0.0056%	0.0070%	0.0125%	0.0175%	0.0167%	0.0131%	0.0055%	0.0087%	0.0088%	0.0152%
Rc < 0.3 nm	6(2)	0.1353%	0.1482%	0.1120%	0.2429%	0.1925%	0.1321%	0.1292%	0.1055%	0.0517%	0.1461%	0.1766%	0.2165%
	6 (Sum)	*0.1412%*	*0.1542%*	*0.1183%*	*0.2510%*	*0.2068%*	*0.1505%*	*0.1474%*	*0.1197%*	*0.0582%*	*0.1568%*	*0.1868%*	*0.2338%*
Rc < 0.2 nm	7	4.9400%	4.6662%	4.8234%	5.9535%	5.3258%	5.1041%	4.8391%	5.2624%	5.7308%	6.0630%	7.0961%	7.9018%
Rc < 0.1 nm	8	94.7767%	95.0353%	94.9417%	93.6618%	94.2878%	94.5927%	94.8360%	94.4705%	94.1175%	93.6675%	92.6185%	91.7730%
Rc < 75 m	9	0.1366%	0.1312%	0.1061%	0.0896%	0.0618%	0.0988%	0.1605%	0.1331%	0.0815%	0.0871%	0.0830%	0.0727%
Rc < 25 m	10	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%
Rc < 7.5 m	11	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%
# reports		2.350E+09	2.622E+09	3.038E+09	3.548E+09	4.239E+09	5.002E+09	5.355E+09	6.117E+09	7.192E+09	8.933E+09	9.588E+09	1.070E+10
# aircraft		2,176	2,180	2,501	3,068	3,463	3,787	4,204	4,802	5,608	6,426	6,766	7,519
reports/aircrft		1,079,796	1,202,973	1,214,647	1,156,426	1,223,965	1,320,763	1,273,760	1,273,915	1,282,473	1,390,210	1,417,063	1,423,663
	<7	0.1467%	0.1673%	0.1287%	0.2951%	0.3246%	0.2044%	0.1644%	0.1340%	0.0703%	0.1824%	0.2023%	0.2524%

2.2.2 Although the number of air carrier aircraft included in the analysis has increased considerably over the two year period (from 2,176 to 7,519 aircraft), the NIC results are relatively consistent over the analysis period. Note the increases in NIC=6 and NIC=7 performance over the past 6 months; this appears to be due to an increased fraction of aircraft with SA On GPS receivers retrofitting during this period.

2.2.3 This analysis of air carrier aircraft NIC/NACp performance includes all major types of GNSS receivers (SA On, SA Aware, and SBAS). An FAA analysis in October 2018 which was limited to aircraft with known SA On GPS receivers showed NIC>6 availability that was worse than indicated in the above results.

2.2.4 The table below is the NIC performance analysis for the two year period ending 9 Aug 2019, as compared to the requirements of 14 CFR 91.227.

Est Position Uncertainty	NACp	2 months ending 9-Oct-2017	2 months ending 9-Dec-2017	2 months ending 9-Feb-2018	2 months ending 9-Apr-2018	2 months ending 9-Jun-2018	2 months ending 9-Aug-2018	2 months ending 9-Oct-2018	2 months ending 9-Dec-2018	2 months ending 9-Feb-2019	2 months ending 9-Apr-2019	2 months ending 9-Jun-2019	2 months ending 9-Aug-2019
EPU >= 10 nm	0	0.0028%	0.0083%	0.0058%	0.0078%	0.0206%	0.0501%	0.0414%	0.0417%	0.0244%	0.0157%	0.0052%	0.0062%
EPU < 10 nm	1	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0001%	0.0000%	0.0001%	0.0001%
EPU < 4 nm	2	0.0000%	0.0000%	0.0000%	0.0000%	0.0001%	0.0000%	0.0000%	0.0000%	0.0001%	0.0001%	0.0001%	0.0001%
EPU < 2 nm	3	0.0001%	0.0001%	0.0000%	0.0001%	0.0003%	0.0001%	0.0002%	0.0001%	0.0002%	0.0001%	0.0002%	0.0001%
EPU < 1 nm	4	0.0000%	0.0002%	0.0002%	0.0001%	0.0000%	0.0000%	0.0000%	0.0000%	0.0002%	0.0001%	0.0002%	0.0003%
EPU < 0.5 nm	5	0.0000%	0.0001%	0.0001%	0.0000%	0.0000%	0.0000%	0.0000%	0.0001%	0.0001%	0.0001%	0.0002%	0.0002%
EPU < 0.3 nm	6	0.0000%	0.0001%	0.0002%	0.0001%	0.0002%	0.0001%	0.0001%	0.0005%	0.0008%	0.0011%	0.0013%	0.0012%
EPU < 0.1 nm	7	0.0009%	0.0018%	0.0017%	0.0020%	0.0030%	0.0004%	0.0011%	0.0012%	0.0022%	0.0045%	0.0052%	0.0090%
EPU < 0.05 nm	8	0.1959%	0.2732%	0.3507%	0.4262%	0.4285%	0.4083%	0.4489%	2.7607%	7.5463%	10.1093%	11.9817%	12.9684%
EPU < 30 m	9	72.1378%	69.3690%	69.6734%	71.6905%	72.1708%	71.2385%	70.2584%	68.1576%	64.7317%	64.2970%	63.3747%	63.2764%
EPU < 10 m	10	24.0991%	26.4292%	26.1138%	24.4240%	23.9237%	25.5557%	26.7846%	26.7127%	25.4476%	23.6106%	23.0814%	22.6529%
EPU < 3 m	11	3.5634%	3.9180%	3.8540%	3.4491%	3.4529%	2.7467%	2.4652%	2.3254%	2.2464%	1.9613%	1.5495%	1.0850%
	<8	0.0038%	0.0106%	0.0080%	0.0102%	0.0242%	0.0508%	0.0429%	0.0436%	0.0280%	0.0218%	0.0126%	0.0172%

2.2.5 Note the increases in NACp=8 and NACp=7 performance over the past 6 months; this mirrors the increase in NIC=6 and NIC=7 during this period and is believed to have the same cause.

3 Conclusion

3.1 The meeting is invited to note the information contained in this paper.

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