International Civil Aviation Organization

Eighth Meeting of the Surveillance Implementation Coordination Group (SURICG/8)

Bangkok, Thailand, 6 – 9 June 2023

Agenda Item 7: Report on surveillance ground system and avionics performance monitoring and improvement in compliance

ADS-B EQUIPAGE AND QUALITY PERFORMANCE OBSERVED IN THE U.S.

(Presented by name of United States/Federal Aviation Administration)

SUMMARY

This paper provides a summary of observed NIC/NACp performance for air carrier aircraft compared to the requirements of the U.S. ADS B mandate, as well as ADS-B equipage trends in the U.S.

1. INTRODUCTION

1.1 As context for the information in this paper, the scope of U.S. ADS-B monitoring should be understood. The U.S. has ADS-B ground stations located in the 48 conterminous states, Alaska, Hawaii, as well as the following U.S. territories: Puerto Rico, U.S. Virgin Islands, Guam, and the Commonwealth of the Northern Mariana Islands. In addition, the U.S. receives ADS-B data from three ADS-B ground stations in Mexico, through a cooperative agreement with Mexico's ANSP. Maps showing the totality of this coverage at a typical turbine-powered aircraft flight level (FL350) are shown in Attachment 1. Note that this coverage extends somewhat beyond the airspace where the U.S. ADS-B mandate (14 CFR 91.225) applies.

1.2 In early 2022, the FAA added the ability within its ADS B Performance Monitor (APM) to compute NIC/NACp performance only when aircraft are within the airspace defined in 14 CFR 91.225[1], which is limited to U.S. domestic airspace. U.S. domestic airspace exists over all land mass regions of the U.S. as defined in 14 CFR § 1.1 and includes the individual states of the U.S. (contiguous and non-contiguous), the District of Columbia, Puerto Rico, and U.S. possessions, including the surrounding territorial waters. Areas beyond 12 nautical miles from the U.S. coastline are considered part of ICAO airspace. U.S. airspace regulations do not apply in ICAO airspace even if the FAA opts to apply domestic air traffic procedures in certain regions of U.S.-managed ICAO airspace.

[1] In general, the U.S. ADS-B mandate applies to operations in Domestic Class A/B/C airspace, and Domestic Class E airspace above 10,000 ft MSL or 2,500 ft above the local terrain, whichever is higher.

2. DISCUSSION

2.1 Observed NIC/NACp performance compared to 14 CFR 91.227 requirements

2.1.1 The FAA's APM automatically generates a report used to analyse how well ADS-B Version 2 systems installed on aircraft are meeting the requirements of the U.S. ADS-B mandate. This paper only discusses the performance of air carrier aircraft; the FAA focuses on air carrier aircraft since general aviation aircraft with ADS-B Version 2 systems usually have Satellite-Based Augmentation System (SBAS) position sources. To ensure statistical validity, detected aircraft with less than 10,000 ADS-B reports during each two-month analysis period are excluded from the results. Additionally, for all analysis results since the beginning of 2022, aircraft with known avionics installation issues (SDA<2, SIL<3, or NACv<1 for more than about 40% of each aircraft's operational time during the analysis period) are also excluded from this analysis – in an average two-month analysis period, this is typically around 10-20 air carrier aircraft during each analysis period. These analysis results include all major types of ADS-B position sources (SA-On, SA Aware, and SBAS) currently available on air carrier aircraft.

2.1.2 During the most recent two-month analysis window ending on 9 April 2023 for the full airspace shown in Attachment 1, just over 30% (2,895 out of 9,493) of the observed air carrier aircraft were registered outside the U.S. However, during the same two-month analysis window for aircraft operating only in the airspace defined by 14 CFR 91.225, about 28%, (2,572 out of 9,160) of the air carrier aircraft were registered outside the U.S.

2.1.3 As used in this paper, "operational availability" is defined as the percentage of time that a system or service is available at the expected level of performance, relative to its expected use. In this paper, the term "outage" typically refers to the system or service dropping below the expected level of performance (versus complete failure of the system or service). Since FAA ATC applications operate at all times, the expected use period does not end. Therefore, 100% operational availability would be a system or service which is continually available at the expected level of performance during the entire measurement period. Traditionally, the FAA has used an operational availability requirement of greater than or equal to 99.9% for each surveillance sensor when engineering FAA ATC surveillance systems. This allows a maximum surveillance sensor "outage" duration of 0.1%, which is about 86 seconds during a given 24-hour period (or almost 9 hours per year). The analysis results discussed in this paper proceed with this surveillance requirement in mind.

2.1.4 As noted above in section 1, the APM is now capable of creating operational availability reports in two forms – one for all ADS-B data received by the U.S. ADS-B ground stations, and one for only the U.S. domestic airspace in which the provisions of 14 CFR 91.225 apply. The latter report is referred to as a "rule airspace" report and the analysis of this report is described in sections 2.1.11 to 2.1.16.

2.1.5 In the tables below, red shading indicates that the ADS-B position quality is insufficient for the data to be used by FAA ATC systems, green shading indicates that the ADS-B position quality meets the requirements of 14 CFR 91.227, and yellow shading indicates that the ADS-B data may be used by ATC but is insufficient to support separation minima of 3 nm or closer. Therefore, for FAA to consistently support 3 nm separation in en route airspace below FL230 using ADS-B data, aircraft must produce "green shading" performance. In the bottom row of each table, orange shading indicates the aggregation of the red and yellow shaded rows, when the requirements of 14 CFR 91.227 are not being met.

2.1.6 NIC performance for air carrier aircraft during the two-year period ending 9 April 2023 is shown in the below table.

							Note: A/C with avg SDA<1.33, NACv<0.66, or SIL<2 are removed from these results						
Radius of Containment (Rc)	NIC	2 months ending 9-Jun-2021	2 months ending 9-Aug-2021	2 months ending 9-Oct-2021	2 months ending 9-Dec-2021	2 months ending 9-Feb-2022	2 months ending 9-Apr-2022	2 months ending 9-Jun-2022	2 months ending 9-Aug-2022	2 months ending 9-Oct-2022	2 months ending 9-Dec-2022	2 months ending 9-Feb-2023	2 months ending 9-Apr-2023
Rc unknown	0	0.0098%	0.0136%	0.0183%	0.0357%	0.0166%	0.0103%	0.0084%	0.0102%	0.0118%	0.0131%	0.0123%	0.0102%
Rc < 20 nm	1	0.0001%	0.0003%	0.0002%	0.0001%	0.0001%	0.0001%	0.0002%	0.0001%	0.0003%	0.0002%	0.0002%	0.0002%
Rc < 8 nm	2	0.0001%	0.0003%	0.0004%	0.0003%	0.0002%	0.0001%	0.0003%	0.0003%	0.0003%	0.0002%	0.0002%	0.0001%
Rc < 4 nm	3	0.0001%	0.0003%	0.0006%	0.0003%	0.0003%	0.0002%	0.0002%	0.0002%	0.0002%	0.0002%	0.0001%	0.0001%
Rc < 2 nm	4	0.0003%	0.0006%	0.0009%	0.0006%	0.0005%	0.0004%	0.0003%	0.0004%	0.0005%	0.0004%	0.0002%	0.0003%
Rc < 1 nm	5	0.0004%	0.0008%	0.0011%	0.0008%	0.0007%	0.0004%	0.0004%	0.0005%	0.0005%	0.0004%	0.0003%	0.0005%
Rc < 0.6 nm	6(0)	0.0006%	0.0004%	0.0006%	0.0005%	0.0005%	0.0002%	0.0002%	0.0003%	0.0002%	0.0003%	0.0001%	0.0002%
Rc < 0.5 nm	6(1)	0.0138%	0.0033%	0.0033%	0.0034%	0.0084%	0.0025%	0.0021%	0.0012%	0.0016%	0.0032%	0.0010%	0.0018%
Rc < 0.3 nm	6(2)	0.1434%	0.1826%	0.1382%	0.1257%	0.0976%	0.0295%	0.0110%	0.0068%	0.0278%	0.0282%	0.0207%	0.0120%
	6 (Sum)	*0.1583%*	*0.1871%*	*0.1432%*	*0.1305%*	*0.1072%*	*0.0326%*	*0.0137%*	*0.0088%*	*0.0302%*	*0.0321%*	*0.0221%*	*0.0145%*
Rc < 0.2 nm	7	5.3641%	4.9668%	4.8961%	4.8395%	5.3147%	4.7676%	4.4369%	3.8917%	4.0658%	3.5675%	3.2447%	2.8407%
Rc < 0.1 nm	8	94.4123%	94.7789%	94.8821%	94.9455%	94.5072%	95.1370%	95.4807%	96.0303%	95.8380%	96.3277%	96.6773%	97.0929%
Rc < 75 m	9	0.0461%	0.0410%	0.0496%	0.0411%	0.0462%	0.0473%	0.0499%	0.0487%	0.0530%	0.0549%	0.0428%	0.0409%
Rc < 25 m	10	0.0088%	0.0110%	0.0085%	0.0063%	0.0069%	0.0045%	0.0093%	0.0094%	0.0000%	0.0037%	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		8.913E+09	1.119E+10	1.098E+10	9.612E+09	1.100E+10	1.118E+10	1.178E+10	1.196E+10	1.179E+10	1.190E+10	1.179E+10	1.249E+10
# aircraft		8,123	8,542	8,746	8,918	9,027	9,050	9,155	9,235	9,277	9,340	9,443	9,493
reports/aircrft		1,097,292	1,310,496	1,255,839	1,077,804	1,218,254	1,235,718	1,286,910	1,295,551	1,270,467	1,273,947	1,248,975	1,315,749
	<7	0.1687%	0.2023%	0.1637%	0.1676%	0.1250%	0.0437%	0.0232%	0.0200%	0.0432%	0.0462%	0.0351%	0.0255%

2.1.7 The NIC results are generally consistent over the analysis period, though there has been an improvement in NIC>6 performance since 2021; this is expected as SA-On GPS position sources are slowly being removed from the air carrier fleet. Note that once NIC falls below 6, the most likely value to be reported is NIC=0.

2.1.8 NACp performance for air carrier aircraft during the period ending 9 April 2023 is shown in the below table.

Est Position Uncertainty	NACp	2 months ending 9-Jun-2021	2 months ending 9-Aug-2021	2 months ending 9-Oct-2021	2 months ending 9-Dec-2021	2 months ending 9-Feb-2022	2 months ending 9-Apr-2022	2 months ending 9-Jun-2022	2 months ending 9-Aug-2022	2 months ending 9-Oct-2022	2 months ending 9-Dec-2022	2 months ending 9-Feb-2023	2 months ending 9-Apr-2023
EPU >= 10 nm	0	0.0055%	0.0040%	0.0071%	0.0110%	0.0080%	0.0050%	0.0053%	0.0039%	0.0052%	0.0069%	0.0058%	0.0060%
EPU < 10 nm	1	0.0000%	0.0000%	0.0001%	0.0000%	0.0000%	0.0000%	0.0000%	0.0001%	0.0000%	0.0001%	0.0001%	0.0002%
EPU < 4 nm	2	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0001%	0.0000%	0.0003%	0.0002%	0.0002%	0.0001%	0.0001%
EPU < 2 nm	3	0.0000%	0.0001%	0.0001%	0.0000%	0.0000%	0.0001%	0.0000%	0.0000%	0.0001%	0.0000%	0.0000%	0.0000%
EPU < 1 nm	4	0.0000%	0.0000%	0.0002%	0.0001%	0.0000%	0.0000%	0.0000%	0.0001%	0.0001%	0.0001%	0.0001%	0.0000%
EPU < 0.5 nm	5	0.0002%	0.0000%	0.0002%	0.0001%	0.0000%	0.0000%	0.0000%	0.0001%	0.0001%	0.0001%	0.0001%	0.0000%
EPU < 0.3 nm	6	0.0008%	0.0004%	0.0009%	0.0011%	0.0005%	0.0005%	0.0004%	0.0004%	0.0005%	0.0005%	0.0005%	0.0002%
EPU < 0.1 nm	7	0.0044%	0.0071%	0.0048%	0.0047%	0.0150%	0.0131%	0.0062%	0.0032%	0.0014%	0.0051%	0.0116%	0.0045%
EPU < 0.05 nm	8	9.9984%	10.2485%	10.3583%	10.1989%	9.8961%	9.8636%	9.7848%	9.6341%	9.6076%	9.5536%	9.0487%	7.5731%
EPU < 30 m	9	57.4094%	56.7015%	55.7895%	54.5780%	54.3724%	54.4397%	54.2403%	53.5885%	52.8062%	51.2732%	49.9289%	47.0670%
EPU < 10 m	10	31.1065%	31.7161%	32.7650%	34.1656%	34.6789%	34.7772%	34.9988%	35.8851%	36.6322%	38.0891%	39.6077%	44.1965%
EPU < 3 m	11	1.4748%	1.3223%	1.0738%	1.0405%	1.0290%	0.9007%	0.9641%	0.8842%	0.9465%	1.0711%	1.3965%	1.1523%
	<8	0.0109%	0.0117%	0.0134%	0.0170%	0.0236%	0.0188%	0.0120%	0.0081%	0.0075%	0.0130%	0.0182%	0.0110%

2.1.9 The overall trends are similar to the NIC analyses results, but it is clear that NACp rule violations are at least an order of magnitude less likely than for NIC. For this and other reasons, NIC performance generally defines the limits for using ADS-B data in ATC operations.

2.1.10 Figure 1 shows the percentage of air carrier aircraft in each bimonthly data sample in all airspace within range of U.S. ADS-B ground stations since the 9-Dec-2019 analysis period which failed to meet the previously defined criteria of NIC>6 at or above 99.900 percent. The increase during the period ending 9-Dec-2021 is currently unexplained. The dashed line is the Excel-computed trend line and shows a declining trend. It is expected that an overall declining trend will contine in the future as air carrier aircraft with newer position sources are introduced (new production aircraft) and as aircraft equipped with GPS SA-On ADS-B position sources are retrofitted with modern position source solutions.

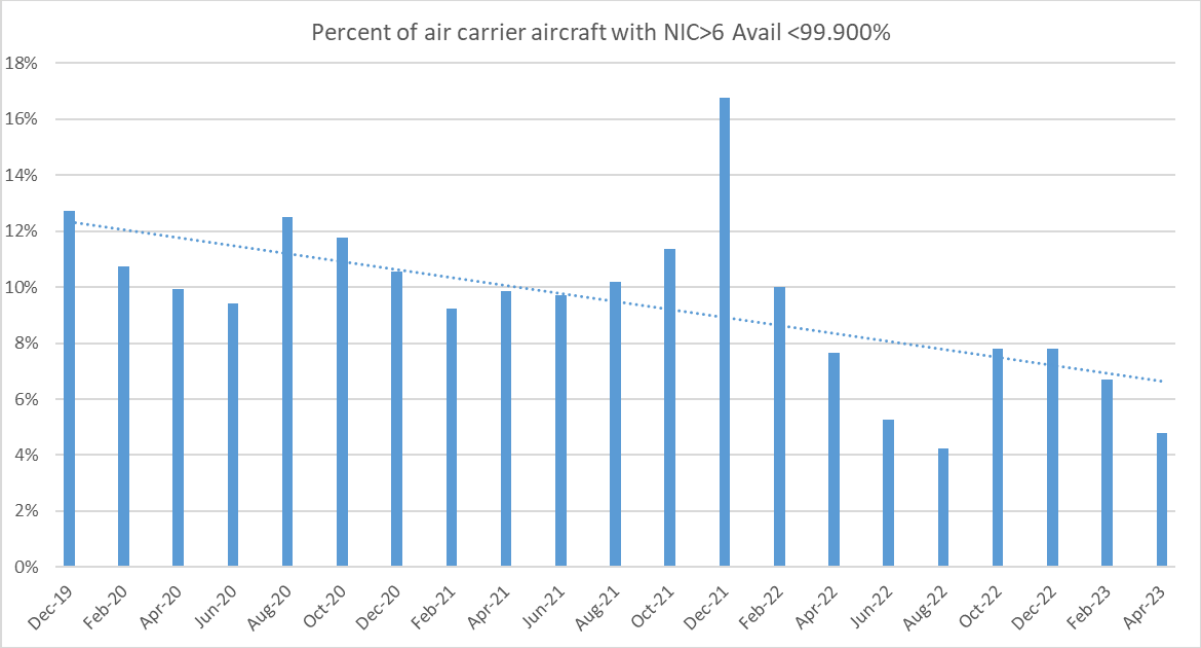

Figure 1 – Percentage of air carrier aircraft not meeting NIC>6 availability criteria

2.1.11 This section through section 2.1.16 presents analyses of operations which are limited to the airspace defined in 14 CFR 91.225 (see section 1.2), in a format equivalent to that provided in 2.1.6 through 2.1.10 above. Since these analyses cover smaller regions of airspace than shown in Attachment 1, the number of air carrier aircraft is lower. The air carrier aircraft excluded are typically operated by non-U.S. air carriers which do not fly in the airspace where the U.S. ADS-B mandate applies.

2.1.12 NIC performance in rule airspace for air carrier aircraft from 9 February 2022 to 9 April 2023 is shown in the below table.

Radius of Containment (Rc)	NIC	2 months ending 9-Apr-2022	2 months ending 9-Jun-2022	2 months ending 9-Aug-2022	2 months ending 9-Oct-2022	2 months ending 9-Dec-2022	2 months ending 9-Feb-2023	2 months ending 9-Apr-2023
Rc unknown	0	0.0089%	0.0068%	0.0081%	0.0102%	0.0122%	0.0109%	0.0085%
Rc < 20 nm	1	0.0001%	0.0002%	0.0001%	0.0003%	0.0002%	0.0002%	0.0003%
Rc < 8 nm	2	0.0001%	0.0003%	0.0003%	0.0003%	0.0002%	0.0002%	0.0002%
Rc < 4 nm	3	0.0002%	0.0002%	0.0002%	0.0003%	0.0002%	0.0001%	0.0001%
Rc < 2 nm	4	0.0004%	0.0003%	0.0004%	0.0006%	0.0004%	0.0002%	0.0003%
Rc < 1 nm	5	0.0005%	0.0004%	0.0006%	0.0005%	0.0004%	0.0003%	0.0005%
Rc < 0.6 nm	6(0)	0.0002%	0.0003%	0.0003%	0.0003%	0.0003%	0.0002%	0.0003%
Rc < 0.5 nm	6(1)	0.0027%	0.0022%	0.0013%	0.0018%	0.0033%	0.0011%	0.0019%
Rc < 0.3 nm	6(2)	0.0319%	0.0119%	0.0071%	0.0294%	0.0302%	0.0223%	0.0130%
	6 (Sum)	*0.0353%*	*0.0148%*	*0.0093%*	*0.0319%*	*0.0342%*	*0.0238%*	*0.0157%*
Rc < 0.2 nm	7	5.0961%	4.7598%	4.1837%	4.3390%	3.8150%	3.4989%	3.0550%
Rc < 0.1 nm	8	94.8131%	95.1682%	95.7504%	95.5666%	96.0859%	96.4254%	96.8835%
Rc < 75 m	9	0.0394%	0.0435%	0.0410%	0.0509%	0.0512%	0.0402%	0.0364%
Rc < 25 m	10	0.0063%	0.0059%	0.0064%	0.0000%	0.0005%	0.0000%	0.0000%
Rc < 7.5 m	11	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%	0.0000%
# reports		9.694E+09	1.020E+10	1.037E+10	1.027E+10	1.036E+10	1.016E+10	1.082E+10
# aircraft		8,755	8,860	8,945	8,948	8,979	9,084	9,160
reports/aircrft		1,107,272	1,151,217	1,158,906	1,148,126	1,154,016	1,118,058	1,180,820
	<7	0.0450%	0.0225%	0.0184%	0.0435%	0.0474%	0.0355%	0.0251%

2.1.13 The NIC results in rule airspace appear comparable to the results in all U.S. ADS-B coverage areas.

2.1.14 NACp performance in rule airspace for air carrier aircraft from 9 February 2022 to 9 April 2023 is shown in the below table.

Est Position Uncertainty	NACp	2 months ending 9-Apr-2022	2 months ending 9-Jun-2022	2 months ending 9-Aug-2022	2 months ending 9-Oct-2022	2 months ending 9-Dec-2022	2 months ending 9-Feb-2023	2 months ending 9-Apr-2023
EPU >= 10 nm	0	0.0052%	0.0037%	0.0046%	0.0067%	0.0059%	0.0068%	0.0056%
EPU < 10 nm	1	0.0000%	0.0001%	0.0000%	0.0002%	0.0001%	0.0001%	0.0002%
EPU < 4 nm	2	0.0000%	0.0002%	0.0002%	0.0002%	0.0001%	0.0002%	0.0002%
EPU < 2 nm	3	0.0000%	0.0000%	0.0001%	0.0000%	0.0000%	0.0000%	0.0000%
EPU < 1 nm	4	0.0000%	0.0001%	0.0002%	0.0001%	0.0001%	0.0000%	0.0000%
EPU < 0.5 nm	5	0.0000%	0.0001%	0.0001%	0.0001%	0.0001%	0.0000%	0.0000%
EPU < 0.3 nm	6	0.0004%	0.0004%	0.0005%	0.0006%	0.0006%	0.0003%	0.0003%
EPU < 0.1 nm	7	0.0067%	0.0035%	0.0015%	0.0055%	0.0125%	0.0081%	0.0049%
EPU < 0.05 nm	8	10.3138%	10.1819%	10.1639%	10.0751%	9.5768%	8.5639%	7.9829%
EPU < 30 m	9	53.1439%	52.5418%	51.8153%	50.4375%	49.0151%	47.6975%	46.0009%
EPU < 10 m	10	35.4762%	36.3005%	36.9816%	38.3119%	39.8696%	42.5087%	44.7381%
EPU < 3 m	11	1.0536%	0.9676%	1.0320%	1.1622%	1.5191%	1.2145%	1.2669%
	<8	0.0124%	0.0082%	0.0071%	0.0133%	0.0194%	0.0155%	0.0112%

2.1.15 The NACp results in rule airspace appear comparable to the results in all U.S. ADS-B coverage areas.

2.1.16 Figure 2 shows the percentage of aircraft in each bimonthly data sample in rule airspace taken since 9-Feb-2022 which failed to meet the previously defined criteria of NIC>6 at or above 99.900 percent. The dashed line is the Excel-computed trend line and shows a slight declining trend, though clearly there are variations in the bi-monthly results around this trend line. It is expected that an overall declining trend will continue in the future as air carrier aircraft with newer position sources are introduced (new production aircraft) and as aircraft equipped with GPS SA-On ADS-B position sources are retrofitted with modern position source solutions. A comparison of Figure 2 with Figure 1 for the same analysis periods in 2022 shows that in general, rule airspace had about one-half to one percent fewer air carrier aircraft which did not meet the criteria of NIC>6 at or above 99.900 percent availability during each analysis period. Note also that although data trends are comparable in Figure 1 and Figure 2 during the last year, the Excel-computed trend line in Figure 2 is different, reflecting the fact that the recent data trend is relatively flat, even though the longer-term trend from Figure 1 is more favorable.

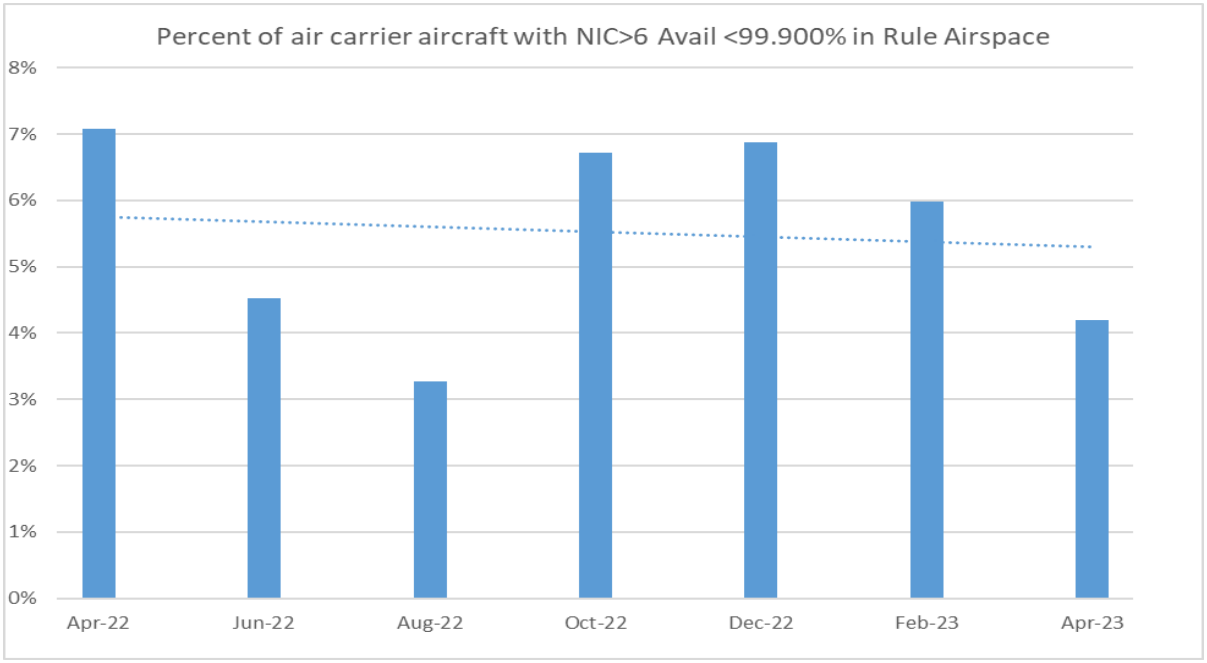

Figure 2 – Percentage of air carrier aircraft in rule airspace not meeting NIC>6 availability criteria

2.1.17 Figures 3 and 4 summarize the NIC>6 Availability performance for air carrier aircraft not meeting NIC>6 Availability of 99.900%, sorted from worst to best performing aircraft operating during the bimonthly period ending 9 April 2023. Figure 3 is for all ADS-B-covered U.S. airspace and Figure 4 is for rule airspace, with the horizontal scale compensated to align with Figure 3 for comparison purposes. These figures show very similar results. It should be noted that causes for degradation in NIC performance can be due to the position source type (GPS SA-On), an aircraft installation issue (including a degraded/faulty GNSS antenna or cabling), a GNSS receiver fault, or GNSS interference testing.

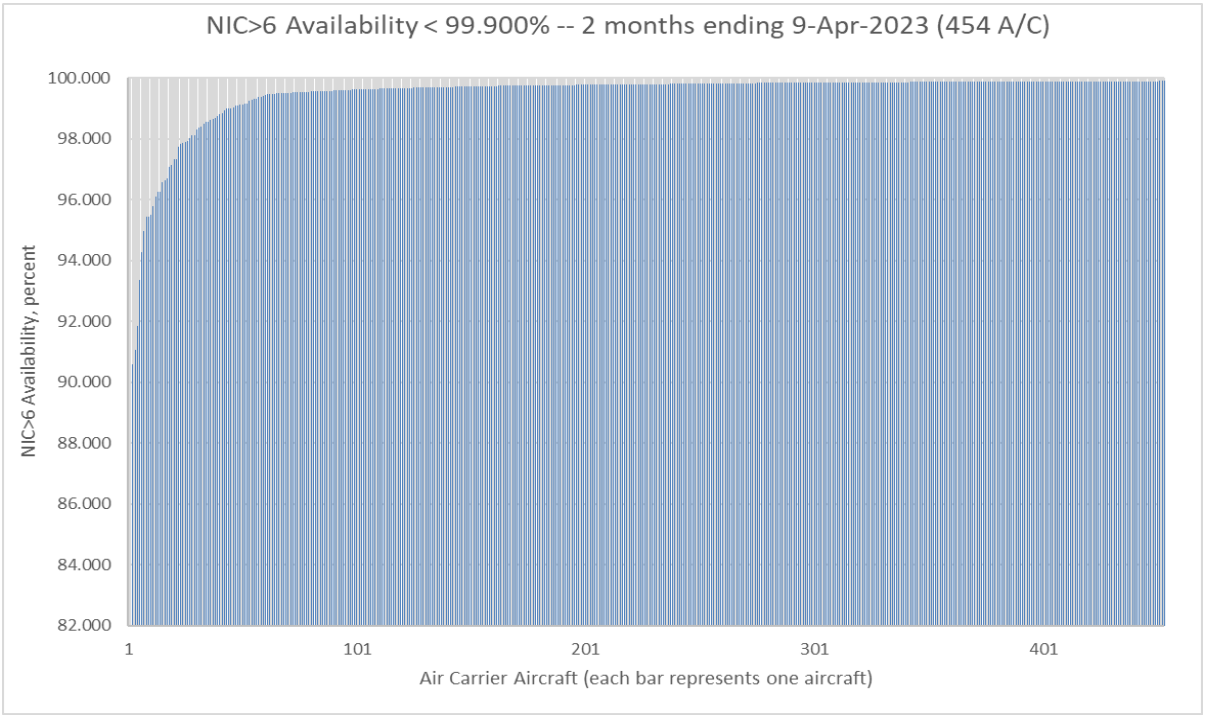

Figure 3 – NIC>6 availability performance for air carrier aircraft not meeting NIC>6 Availability of 99.900%, sorted from worst to best NIC>6 Availability performance (two aircraft were below 82%)

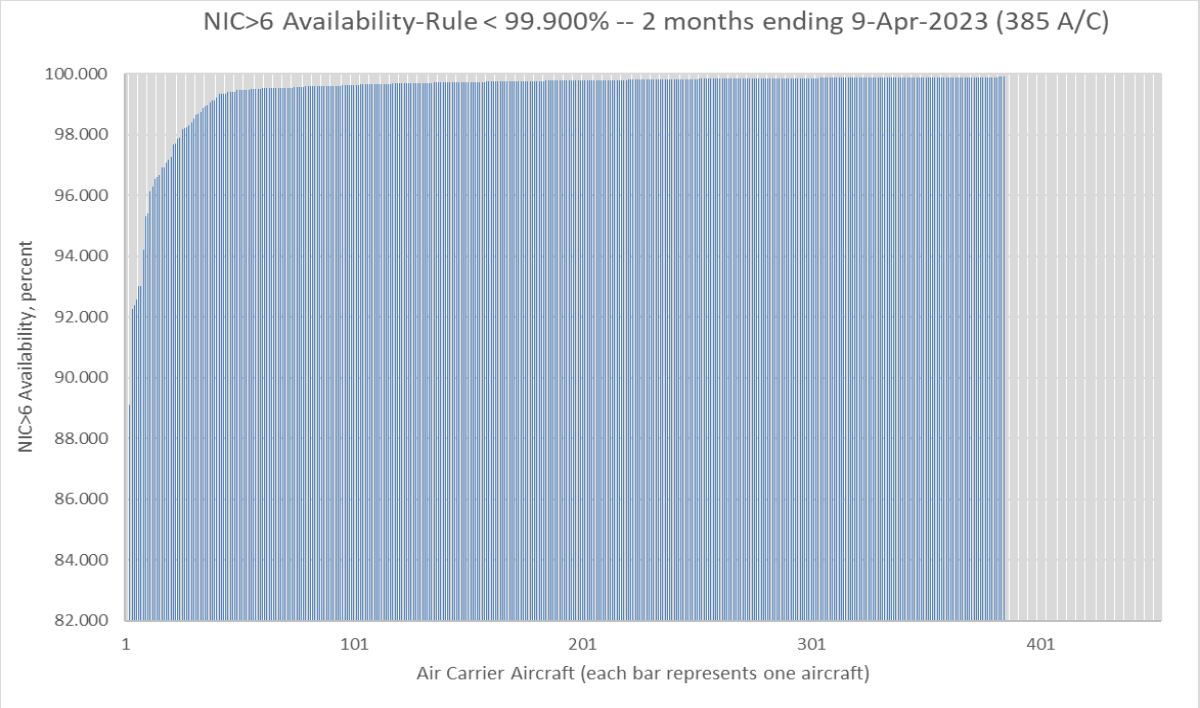

Figure 4 – NIC>6 availability performance in rule airspace for air carrier aircraft not meeting NIC>6 Availability of 99.900%, sorted from worst to best NIC>6 Availability performance (horizontal scale compensated to align with Figure 3 for comparison purposes) (two aircraft were below 82%)

2.2 Tracking ADS-B Equipage Trends in the U.S. The FAA's APM also 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 number of detected addresses during the year prior to the count period. For example, the count of ICAO aircraft addresses in May 2023 includes all addresses detected since May 2022. If an ICAO aircraft address is not detected for over a year, it is dropped from the current month's count. Other facts to note include the reality that incorrect ICAO aircraft addresses are counted just the same as "correct" ones, and if multiple aircraft use a single ICAO aircraft address, the address is only counted once. An example of an "incorrect" ICAO aircraft address is the use of an ICAO aircraft address which is outside of any address block allocated by ICAO to an ICAO-contracting State.

2.2.2 Note that the APM is counting ICAO aircraft addresses detected within U.S. ADS-B coverage, regardless of airspace class; therefore, some ADS-B-equipped aircraft are detected which do not fly in the airspace where the U.S. ADS-B mandate applies.

2.2.3 The FAA APM was out of service for 10 days during November 2021; during this period, no ADS-B data was received or processed by the APM. Thus, operations data for November 2021 in the sections below should be ignored.

2.2.4 Figure 5 shows the number of ICAO aircraft addresses with different ADS B versions since May 2021. During this period, the number of ADS B Version 0 ICAO aircraft addresses decreased from 353 to 223; the number of ADS B Version 1 ICAO aircraft addresses decreased from 198 to 148. In contrast, ADS-B Version 2 ICAO aircraft addresses increased from 168,405 to 184,799.

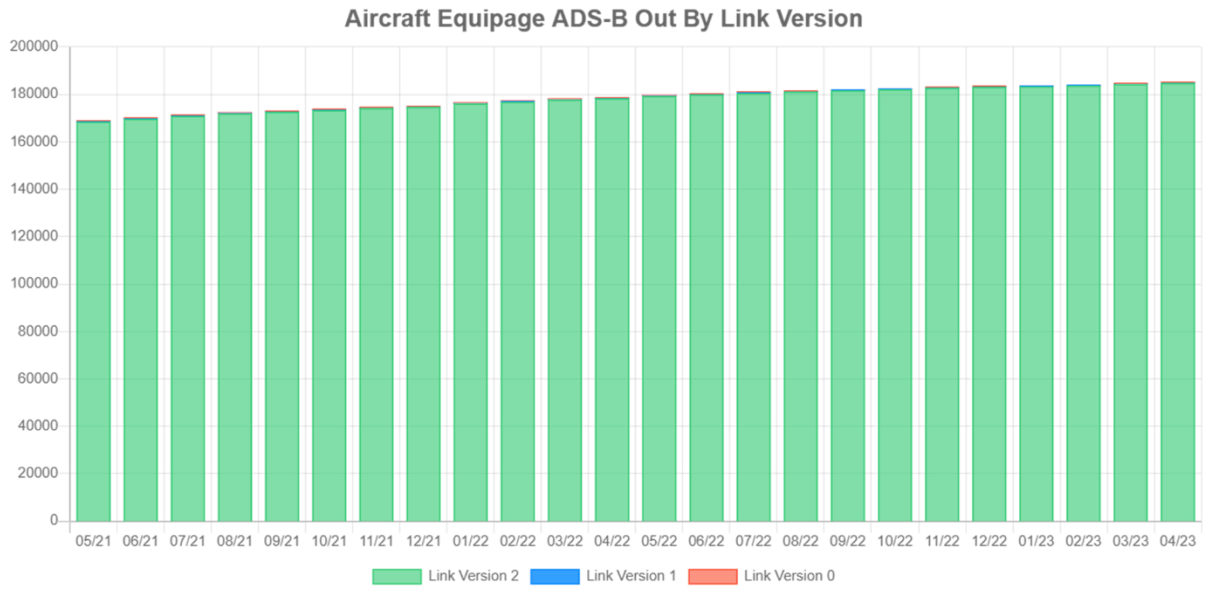

Figure 5 – ICAO aircraft address by ADS-B Version (Link Version)

2.2.5 The APM is also capable of showing data by "link type" – this is useful for understanding the relative fraction of UAT and 1090ES equipage in the U.S. Figure 6 shows the number of ICAO aircraft addresses using different ADS-B technologies since May 2021. Since the U.S. allows use of either 1090ES or UAT ADS-B Out devices, the APM tracks these categories, along with a "Dual" category (the same ICAO aircraft address received on both links at the same time, as some operators have elected to equip their aircraft with both a 1090ES and UAT device to ensure that their aircraft will be "seen" in U.S. airspace where FAA ADS-R service coverage does not exist.

2.2.6 During the period shown, the number of ICAO aircraft addresses received via 1090ES has increased from 126,638 to 141,563, the number of ICAO aircraft addresses received via UAT increased from 40,425 to 42,146 before recently declining to 41,914, and the number of ICAO aircraft addresses registering in the APM as "Dual"-equipped has remained roughly flat at around 1,300.

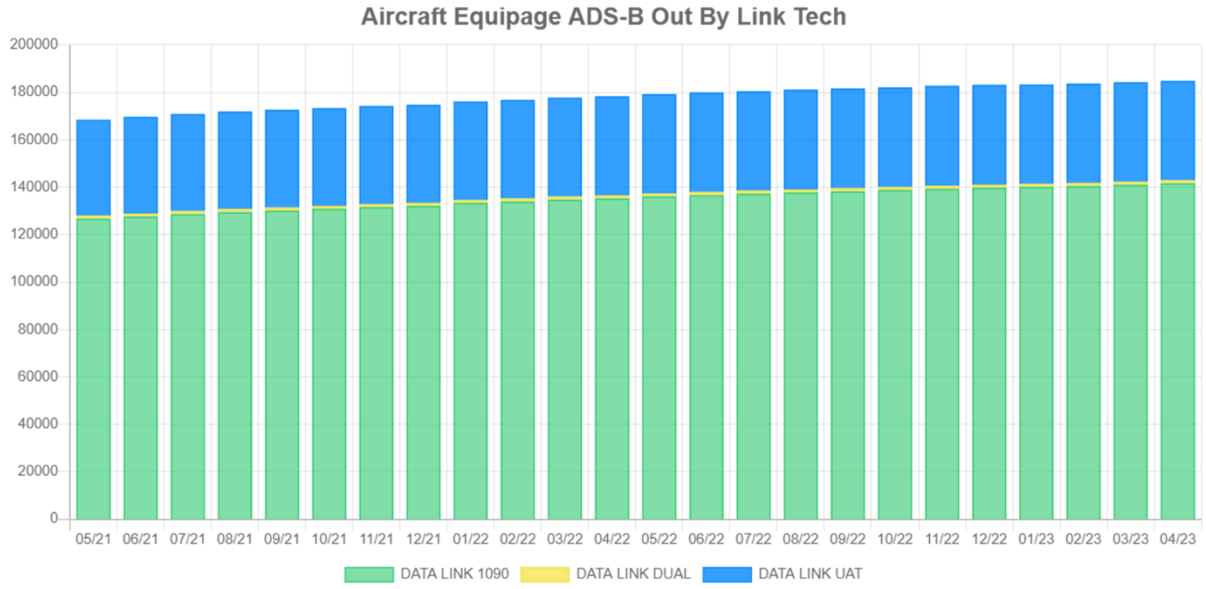

Figure 6 – ICAO aircraft addresses by ADS-B Link Type (1090ES, UAT, or DUAL)

2.2.7 The APM can also display equipage trends as they impact flight operations. An operation in the APM is defined as the consecutive receipt of ASTERIX reports from the first report until reports are no longer detected by an FAA ADS-B service volume. For aircraft which operate continuously within FAA ADS-B coverage and do not turn off their transponder at the gate, an operation will automatically terminate after 8 hours. Figure 7 shows the number of operations by different ADS-B versions since May 2021. During this period, the number of ADS-B Version 0 operations remained in the range of about 280-550 per month; the number of ADS-B Version 1 operations decreased from 565 per month to around 250 per month. In contrast, ADS-B Version 2 operations ranged from a low of 1,837,167 per month (Feb 2022) to a peak of 2,560,070 per month in July 2022. Recall from section 2.2.2 that the "dip" in November 2021 operations is inaccurate.

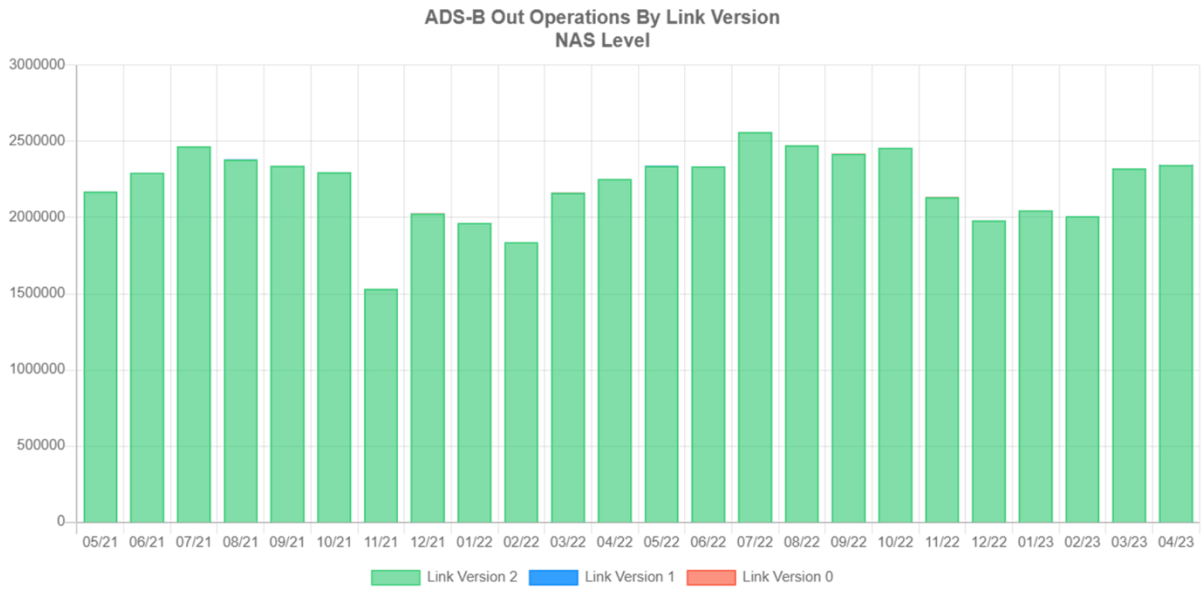

Figure 7 – Aircraft ADS-B Out Operations by ADS-B Version (Link Version)

2.2.8 Figure 8 shows the number of operations by different ADS-B-In link types since May 2021. Note that ADS-B Version 1 is incapable of reporting "Dual" In, so all "Dual" In configurations are being reported by ADS-B Out Version 2 systems. During this period, the number of 1090ES ADS-B-In operations has ranged from a low of 152,503 per month to 202,832 per month; the number of UAT ADS-B-In operations has ranged from 108,692 per month to 196,806 per month. Meanwhile, the number of Dual-In ADS-B-In operations has ranged from 560,854 per month to 882,951 per month. The seasonal variations seen in this two-year data sample show that most ADS-B-In systems are installed in general aviation aircraft – these aircraft fly more often in the summer than in the winter. Recall from section 2.2.2 that the apparent "dip" in November 2021 operations is inaccurate.

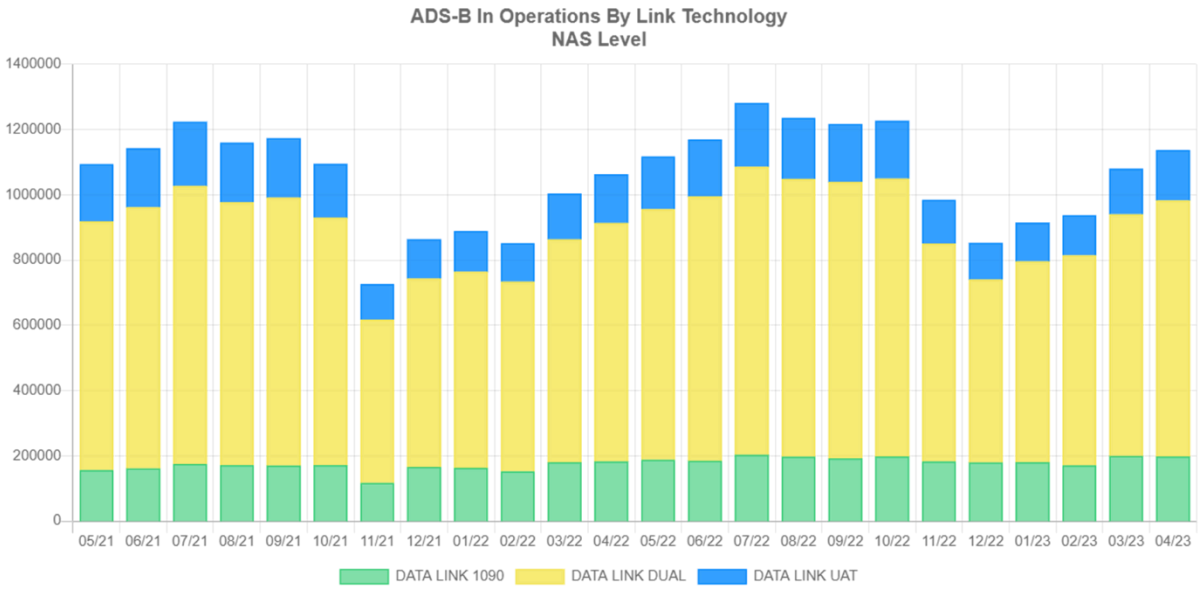

Figure 8 – Aircraft ADS-B In operations by ADS-B Link Type (1090ES, UAT, or DUAL)

3. CONCLUSION

3.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matters as appropriate.

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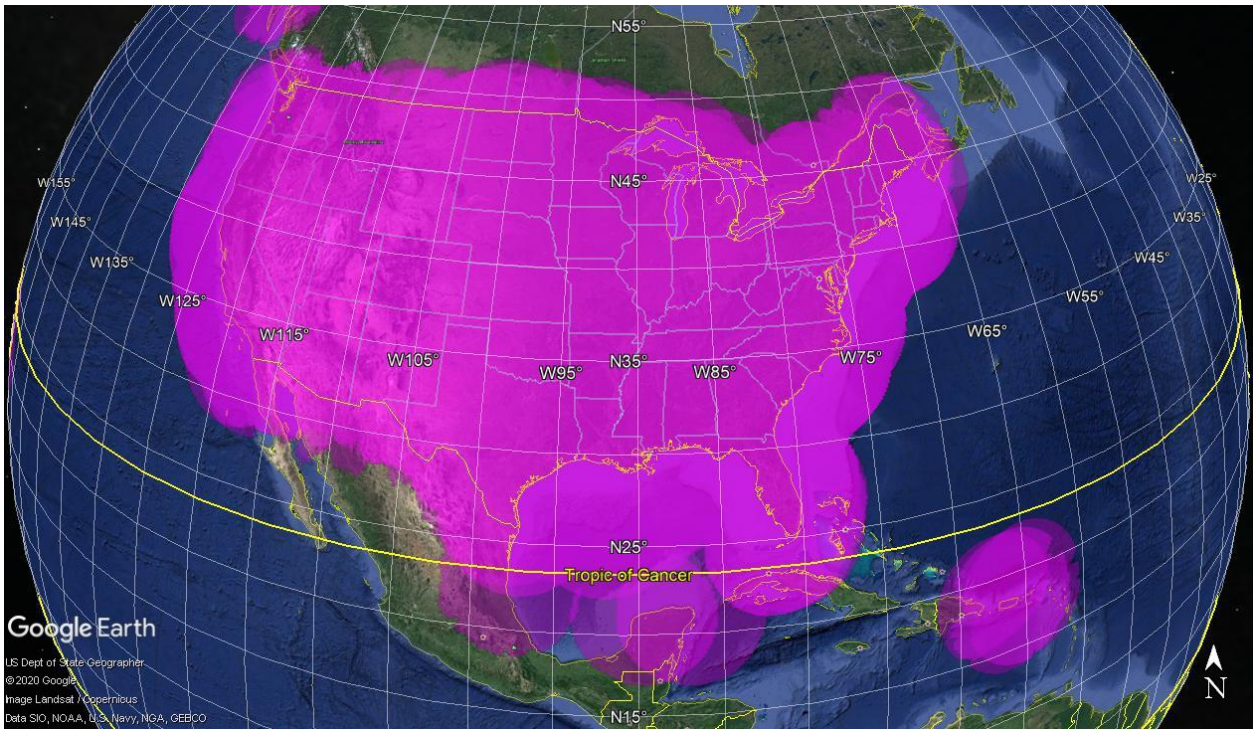
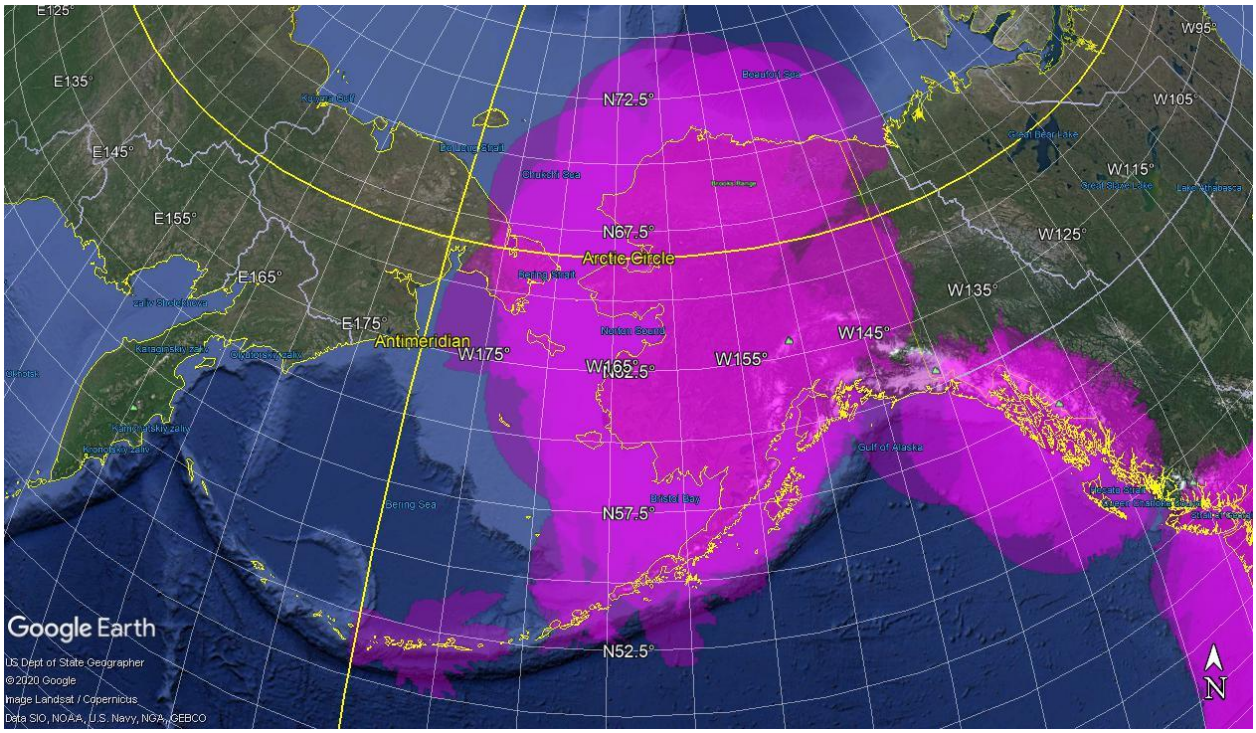
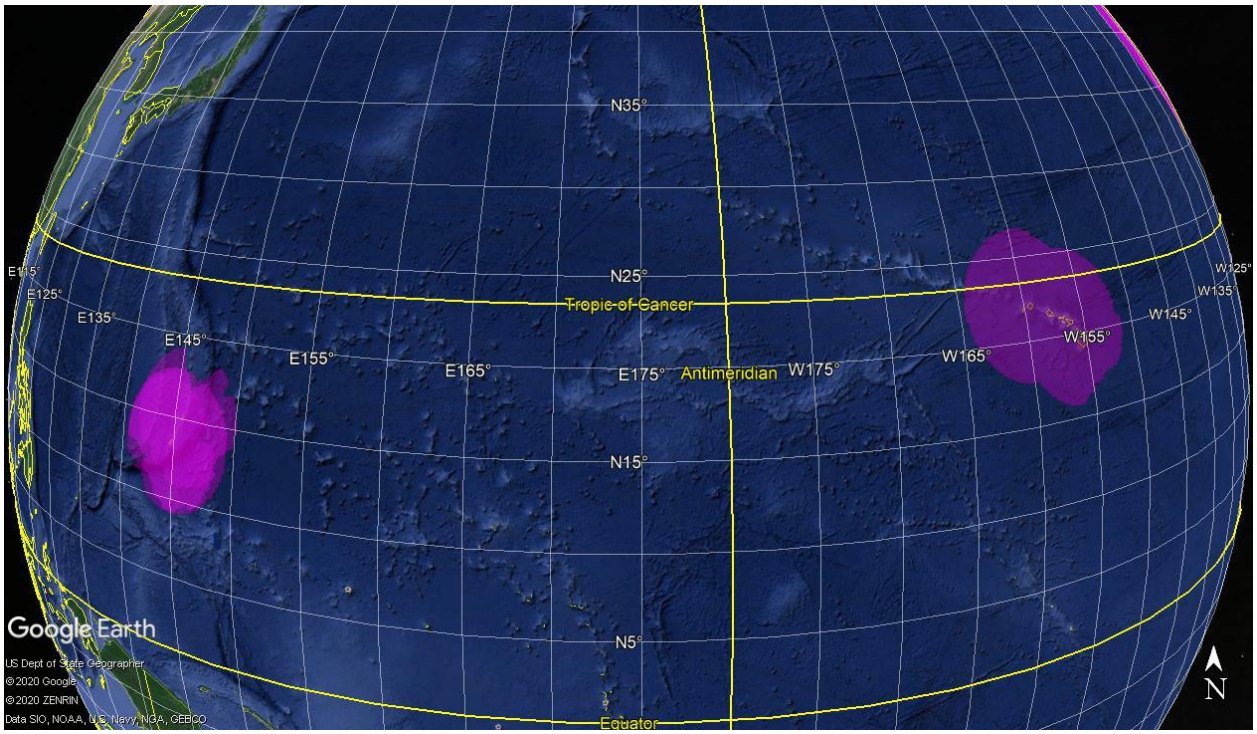
FAA ADS-B Coverage at FL350 (shading intensity indicates degree of overlap in coverage)



North America and Puerto Rico/Virgin Islands



Northwestern North America (Alaska)



Guam/CNMI and Hawaii

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