International Civil Aviation Organization

Tenth Meeting of the Surveillance Implementation Coordination Group (SURICG/10)

Bangkok, Thailand, 21-23 April 2025

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

ADS-B EQUIPAGE AND QUALITY PERFORMANCE OBSERVED IN THAILAND

(Presented by Thailand)

SUMMARY

This paper provides a brief summary of observed NIC/NACp values to assess performance quality of aircraft using ADS-B in Thailand, along with ADS-B equipage status in Thailand.

1. INTRODUCTION

1.1 Since September 2024, seven ADS-B ground stations have been installed and integrated into the Air Traffic Management Automation System (ATMAS) in Thailand to enhance the efficiency, flexibility, and coverage of ATS surveillance within the Bangkok Area Control Center and selected Approach Control Centers. To address concerns regarding ADS-B performance within the Bangkok FIR, the Aeronautical Radio of Thailand, AEROTHAI (Thailand's ANSP), has initiated a monitoring program to assess ADS-B quality indicators at each ADS-B station.

2. DISCUSSION

2.1 Observed NIC/NACp performance of ADS-B reports of Thailand FIR in 2024

2.1.1 This paper focuses on ADS-B reports (ASTERIX CAT021) collected over a one-year period in 2024 of four ADS-B receivers with site monitor reports excluded. The four ADS-B receivers are located at Doi Inthanon (Chiangmai), Hatyai Airport (VTSS), Samui Airport (VTSM) and Ubon Ratchathani Airport (VTUU) as shown in Figure 1. Only four of seven ADS-B receivers were used since data from the SSRs that have been upgraded with ADS-B capability due not to encompass the whole year.

2.1.2 ADS-B messages encompass positional performance indices (NIC and NACp) so in this paper these values are analyzed, but the information concerning avionics installation issues (SDA, SIL, NACv) are not used to evaluate the performance of aircraft. According to 14 CFR 91.227, ADS-B Out performance requirements include:

- NIC ≥ 7
- NACp ≥ 8

2.1.3 The analysis begins by assessing the percentage of various performance indices, including the Integrity Containment Bound (RC) in NUCp for DO-260 reports and in NIC for both DO-260A and DO-260B reports. Based on ASTERIX CAT021 version 2.1, which is used in all ADS-B ground stations in Thailand, the conversion among the PIC value (ADS-B position integrity), NUCp and NIC is shown in

Table 1. This is used to assess the overall integrity of the ADS-B position data. Additionally, the Estimated Position Uncertainty, which is directly related to NACp, will also be analyzed.

Figure 1 - The location of four ADS-B stations which data was collected for the analysis

2.1.4 Table 1 and 2 are the statistical results for all collected ADS-B data**.** In the tables below, green shading indicates that the ADS-B position quality meets the requirements of 14 CFR 91**.**227**.**

Rc	PIC	NUC	NIC V1	NIC V2	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
> 20NM	0	0	0	0	0.20%	0.16%	0.17%	0.48%	0.45%	0.39%	0.36%	0.49%	0.51%	0.75%	0.64%	0.88%
< 20NM	1	1	1	1	0.00%	0.00%	0.01%	0.01%	0.03%	0.02%	0.02%	0.00%	0.01%	0.00%	0.01%	0.01%
< 10NM	2	2	-	-	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
< 8NM	3	-	2	2	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%	0.01%	0.01%	0.02%	0.01%	0.01%
< 4NM	4	-	3	3	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.00%	0.01%	0.01%	0.01%	0.01%	0.01%
< 2NM	5	3	4	4	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.03%	0.03%	0.02%	0.03%
< 1NM	6	4	5	5	0.04%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.04%	0.03%	0.03%
< 0.6NM	7	-	6	6 (1/1)	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	0.05%	0.03%	0.03%
< 0.5NM	8	5	6	6 (0/0)	1.19%	0.60%	0.40%	0.29%	0.28%	0.30%	0.28%	0.28%	0.31%	0.38%	0.38%	0.44%
< 0.3NM	9	-	6	6 (0/1)	0.06%	0.04%	0.05%	0.05%	0.06%	0.06%	0.05%	0.05%	0.05%	0.10%	0.04%	0.05%
				6 (sum)	1.29%	0.67%	0.48%	0.37%	0.38%	0.39%	0.36%	0.36%	0.38%	0.53%	0.45%	0.52%
< 0.2NM	10	6	7	7	9.97%	8.67%	8.08%	7.98%	7.73%	7.54%	7.28%	7.82%	7.24%	9.12%	7.70%	8.02%
< 0.1NM	**11**	**7**	**8**	**8**	**88.30%**	**90.22%**	**90.91%**	**90.80%**	**91.08%**	**91.37%**	**91.59%**	**91.02%**	**91.58%**	**89.26%**	**90.93%**	**90.22%**
< 0.04NM	12	-	9	9	0.13%	0.18%	0.24%	0.26%	0.23%	0.19%	0.29%	0.23%	0.19%	0.21%	0.17%	0.22%
< 0.013NM	13	8	10	10	0.02%	0.03%	0.04%	0.03%	0.04%	0.04%	0.04%	0.01%	0.02%	0.02%	0.03%	0.04%
< 0.004NM	14	9	11	11	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	<10	**<6**	**<7**	**<7**	**1.57%**	**0.90%**	**0.72%**	**0.94%**	**0.93%**	**0.87%**	**0.80%**	**0.93%**	**0.98%**	**1.41%**	**1.19%**	**1.50%**
#aircraft					5181	5084	5118	5105	5234	5204	5359	5389	5473	4881	5736	5979

Table 1 - Integrity Containment Bound Statistical Analysis from ADS-B Reports in 2024

2.1.5 Table 1 shows that most of the Integrity Containment Bound was less than 0.1 NM, with approximately 90% of the reports indicating NUCp = 7 for DO-260 ADS-B reports and NIC = 8 for DO-260A and DO-260B ADS-B reports. There has been a decline in NIC <7 performance and then a slight increase at the end of the year as shown in Figure 2.

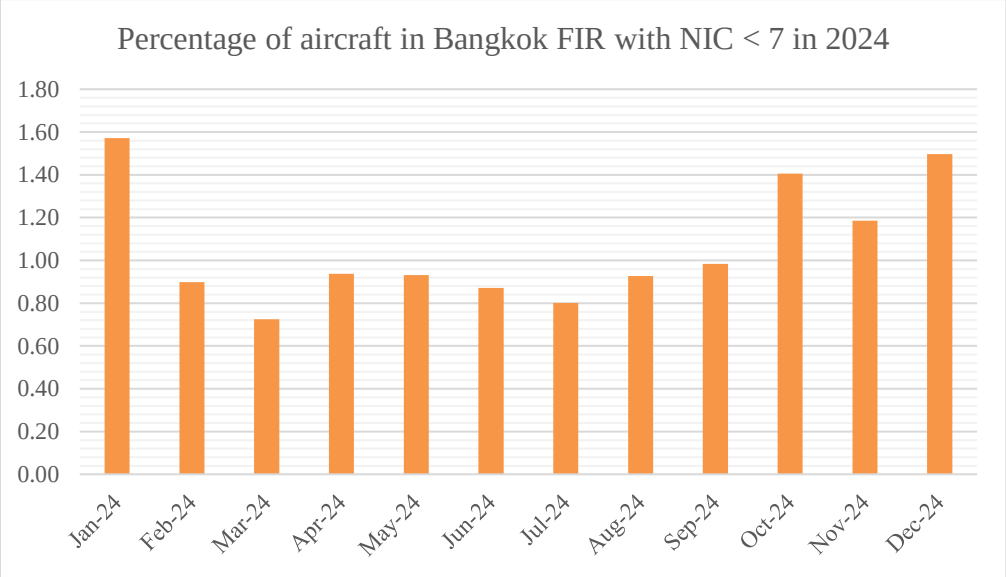

Figure 2 - Percentage of aircraft in Bangkok FIR with NIC < 7 in 2024

2.1.6 Moreover, the Estimated Position Uncertainty (EPU) was also mostly less than 30 m, with approximately 67.68% of reports indicating NACp = 9 for DO-260A and DO-260B ADS-B reports as shown in Table 2.

EPU	NACp	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
≥ 10 NM	0	1.16%	1.15%	1.16%	1.65%	1.59%	1.40%	1.30%	1.56%	1.61%	2.32%	1.79%	1.98%
≤ 10 NM	1	0.00%	0.00%	0.00%	0.01%	0.03%	0.02%	0.02%	0.00%	0.01%	0.00%	0.02%	0.00%
≤ 4 NM	2	0.00%	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.01%
≤ 2 NM	3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
≤ 1NM	4	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.00%	0.00%	0.01%	0.00%	0.00%	0.02%
≤ 0.5 NM	5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
≤ 0.3 NM	6	0.03%	0.02%	0.02%	0.03%	0.02%	0.02%	0.03%	0.03%	0.03%	0.05%	0.03%	0.04%
≤ 0.1 NM	7	0.09%	0.06%	0.07%	0.06%	0.06%	0.07%	0.07%	0.07%	0.06%	0.10%	0.07%	0.07%
≤ 0.05 NM	8	34.68%	31.06%	27.03%	26.71%	26.68%	27.47%	29.02%	29.96%	30.50%	27.54%	28.15%	27.60%
≤ 30 m	**9**	**62.75%**	**66.45%**	**70.27%**	**70.00%**	**69.81%**	**69.01%**	**67.86%**	**66.56%**	**65.88%**	**67.33%**	**68.01%**	**68.24%**
≤ 10 m	10	1.29%	1.26%	1.43%	1.51%	1.78%	1.98%	1.69%	1.80%	1.88%	2.61%	1.91%	2.03%
≤ 3 m	11	0.00%	0.00%	0.00%	0.01%	0.00%	0.01%	0.00%	0.01%	0.00%	0.02%	0.01%	0.00%
	< 8	**1.28%**	**1.23%**	**1.27%**	**1.77%**	**1.73%**	**1.53%**	**1.42%**	**1.67%**	**1.74%**	**2.50%**	**1.93%**	**2.13%**
#aircraft		4669	4594	4638	4594	4716	4701	4837	4887	4983	4414	5254	5494

Table 2 - Estimated Position Uncertainty Statistical Analysis from ADS-B Reports in 2024

2.1.7 Figure 3 shows the percentage of aircraft in each month of 2024 which failed to meet the previously defined criteria of NACp ≥ 8. The figure shows a slightly increasing trend, very similar to the trend of NIC<7 performance in Figure 2, which will be further analyzed.

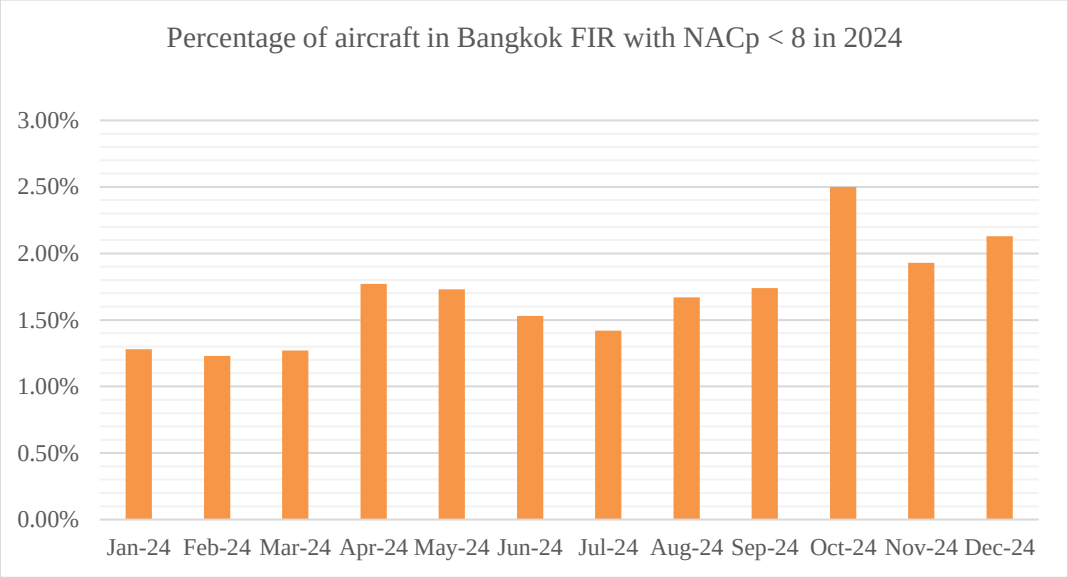

Figure 3 - Percentage of aircraft in Bangkok FIR with NACp < 8 in 2024

2.2 ADS-B equipage trends in Thailand

2.2.1 Figure 4 shows the coverage of 12 SSRs and 4 ADS-B systems within the Bangkok FIR. Figure 5 displays the intersection among Bangkok FIR, the coverage of SSRs and ADS-B, which is used to evaluate the number of ADS-B equipped within the FIR.

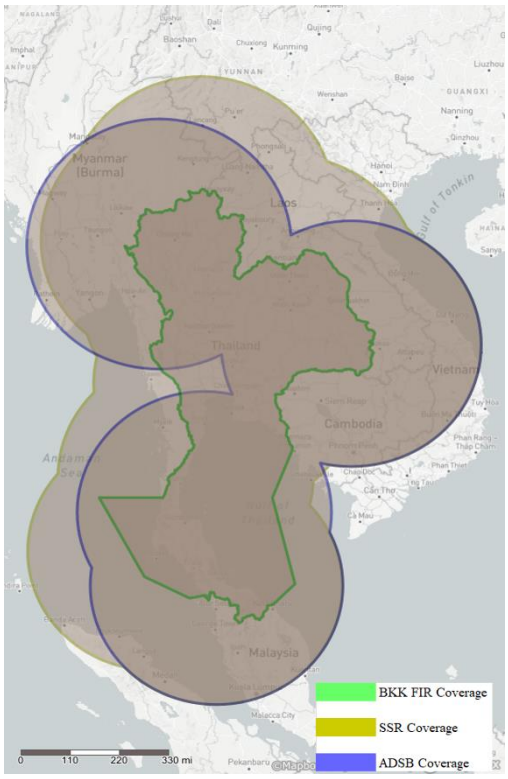

Figure 4 - Coverage of SSR and ADS-B of Bangkok FIR

Figure 5 – Intersected coverage of SSR, ADS-B and Bangkok FIR

2.2.2 A statistic of unique ICAO aircraft address in the year 2024 within the intersected coverage is shown in figure 5. Figure 6 shows the percentage of aircraft equipped with ADS-B compared to aircraft tracked by SSR within the intersected coverage in 2024, with an average value of 93.4 percent.

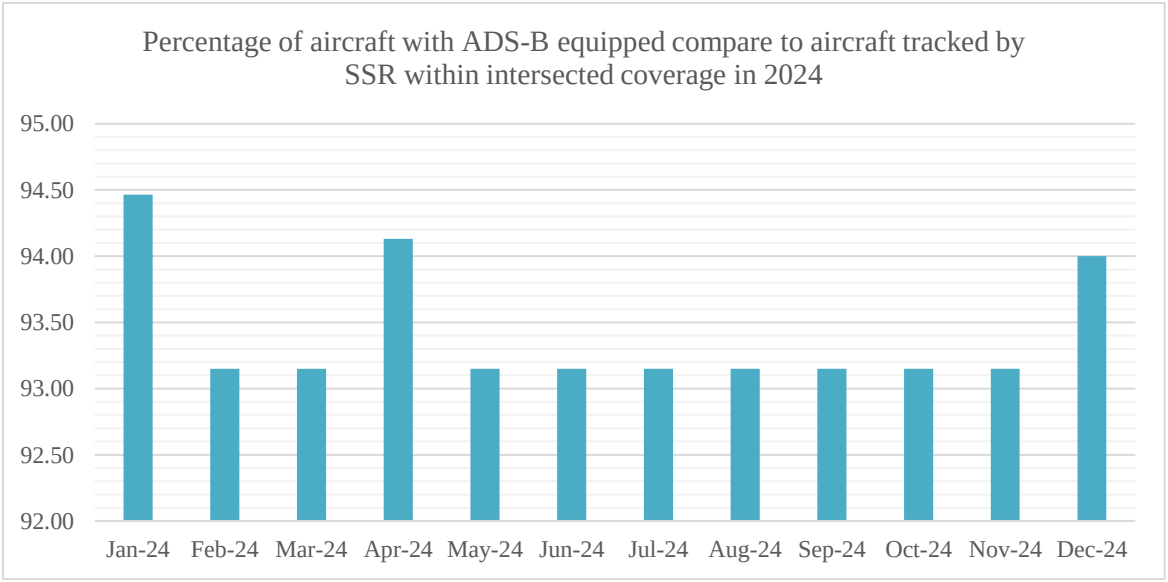

Figure 6 – Percentage of aircraft with ADS-B equipped compare to aircraft tracked by SSR within intersected coverage in 2024

2.2.3 Figure 7 shows the percentage of operations by different ADS- B versions in 2024. During this period, the number of ADS-B Version 0 operations remained in the range of about 9 – 15 percent

per month; the number of ADS- B Version 1 operations is only 1 - 2 percent per month. In contrast, ADS-B Version 2 operations ranged from 84 – 89 percent per month.

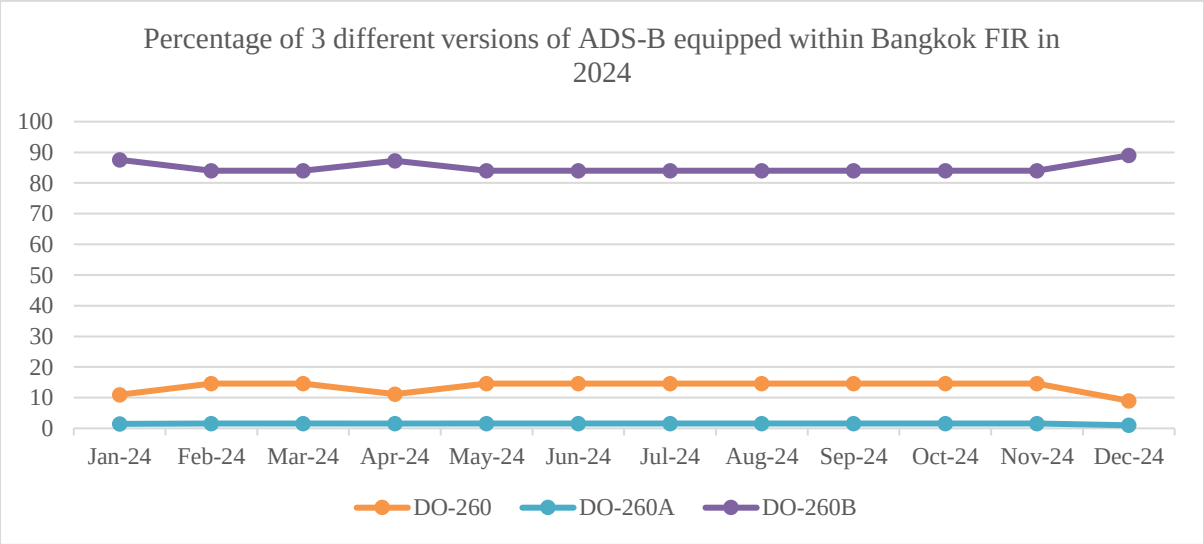

Figure 7 – Percentage of 3 different versions of ADS-B equipped within Bangkok FIR in 2024

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matter as appropriate

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