International Civil Aviation Organization

Twenty Seventh Meeting of the Communications/ Navigation and Surveillance Sub-group (CNS SG/27) of APANPIRG

Bangkok, Thailand, 28 August – 01 September 2023

Agenda Item 7: Surveillance

7.2 Other surveillance related matters

IMPLEMENTATION OF ADS-B VERIFICATION TECHNOLOGIES FOR OPERATIONAL SURVEILLANCE SYSTEM IN JAPAN

(Presented by Japan)

SUMMARY

In this paper, we present the implementation status of ADS-B anti-spoofing function used for ATC system in Japan. To date, ENRI (Electronic Navigation Research Institute) has studied the ADS-B verification technologies to address the security concerns. JCAB is planning to adopt the technologies based on the studies by ENRI, and introduce them into the surveillance sensors for ATC operations.

1. INTRODUCTION

1.1 Although ADS-B is a highly accurate and high-frequency surveillance method, false position information is a concern since ADS-B has neither encryption nor authentication mechanisms. In particular, position spoofing by third parties is a potential threat to ADS-B.

1.2 ENRI has been working on this issue. The results of the research were reported in CNS SG/26-IP/14. ENRI has focused on two main methods.

1.3 One is a position verification method using Time-Difference of Arrival (TDOA) technique. This technique measures the TDOA of the ADS-B signals with at least two receivers to compare and verify the ADS-B position information.

1.4 The other is the reasonableness test of the compact position reporting (CPR) decoding as a supplementary method; CPR is a format for encoding/decoding ADS-B position information. The reasonableness test is a method to verify the decoded position information. This test rejects signals from uncompliant sources with CPR encoding. Although this method is not originally intended as a security measure, it can reduce some of the false targets that are intentionally transmitted.

2. EXPERIMENTAL EVALUATION PHASE (ENRI)

2.1 In the experimental evaluation phase, ENRI constructed an experimental system for the TDOA method consisting of two sets of antenna/receiver and a processing unit. As shown in Fig. 1, spoofing experiments were conducted for 24 hours with good results, detecting anomalous signals with a probability of 99.81%. The results were reported in SURICG/5-WP/7 and contributed to the update of the ADS-B Implementation and Operations Guidance Document (AIGD).

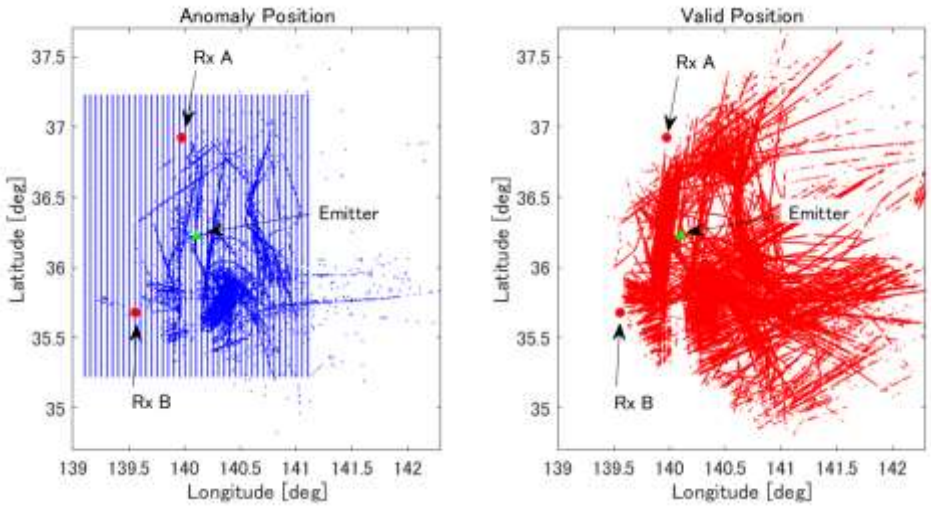

Fig.1. Result of the 24-hour spoofing experiment: (left) the positions determined as anomalous and (right) the positions determined as valid. (cited from CNS SG/26-IP14)

2.2 ENRI also confirmed the effectiveness of reasonableness test for CPR decoding by computer simulation. The reasonableness test is a method of verifying decoded latitude/longitude and is specified in RTCA DO-260B. ENRI experiments showed that the test rejected computationally generated false targets with CPR encoding, and can prevent the intentional illegal transmissions. The results were reported in SURICG/7-WP/11 and contributed to an updated draft of the AIGD.

3. IMPLEMENTATION AND DEVELOPMENT PHASE (JCAB)

3.1 Based on the results of the above ENRI study, JCAB will implement the verification technologies as the *anti-spoofing function* in the ADS-B ground station.

3.2 JCAB began technical studies in 2022 and developed the system specification in 2023. The anti-spoofing function consists of the position verification function using TDOA and a supplementary function to detect position jumps using CPR decoding method.

3.3 For the average detection rate of spoofing, it is assumed that the source of illegal transmission can exist with uniform probability within the coverage area, and the system is required to detect them with a probability of 90% or higher.

3.4 JCAB is currently developing the prototype ADS-B ground station with the above anti-spoofing function. Prior to deployment of ADS-B stand-alone ground station for ATC operation, technical evaluation will be conducted with this prototype.

3.5 JCAB plans to use ADS-B data obtained from en-route WAM, and will integrate them to the upgraded surveillance system in 2025. JCAB also plans to expand the radar control area by using ADS-B stand-alone ground station, especially in non-radar areas at and around the boundary between Fukuoka FIR and Manila FIR.

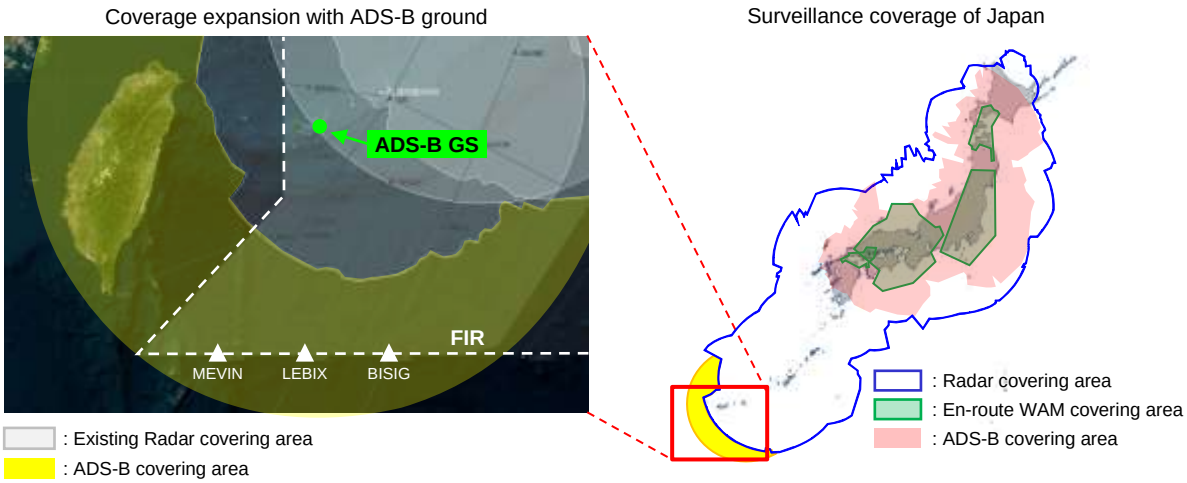

Fig.2. JCAB surveillance coverage expansion plan

4. ACTION BY THE MEETING

4.1 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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