International Civil Aviation Organization

MIDANPIRG Communication, Navigation and Surveillance Sub-Group

Eighth Meeting (CNS SG/8)
(Cairo, Egypt, 26 - 28 February 2018)

Agenda Item 4: CNS Planning and Implementation in the MID Region

CHALLENGES AND MITIGATION OF SECURITY ISSUES ASSOCIATED WITH USING ADS-B SURVEILLANCE SYSTEM

(Presented by Egypt)

SUMMARY

This paper presents a brief overview of the security aspects regarding using Automatic Dependent Surveillance-Broadcast (ADS-B), various techniques used to mitigate these security threats and the proposed ADS-B interference reporting form to be used among member States and the ICAO MID office.

Action by the meeting is at paragraph 3.

REFERENCES

- ICAO standards and recommended practices ANNEX 17.
- ICAO ATM Security Manual, Doc 9985.
- ICAO Aviation Security Manual, Doc 8973.

1. INTRODUCTION

1.1 With the fast-growth of passenger numbers, air navigation applications receive significant attention to embrace such a rapid increase in the number of flights. Where, according to the International Air Transport Association (IATA), the passenger numbers are expected to attain 7.3 billion by 2034. That is equivalent to a 4.1% average annual growth. To realize such huge increase in the air traffic density, many challenges have arisen. One of the most critical challenges to realize such increase in air traffic density is to decrease the minimum separation between aircraft which necessitates precise aircraft positioning techniques. Currently, Automatic Dependent Surveillance-Broadcast (ADS-B) is commonly used rather than traditional surveillance techniques, primary and secondary radar, due to high accuracy and very low ground cost. Unfortunately, security was not considered of the design of ADS-B protocol. Consequently, it is prone to security threats.

1.2 Hence, with the rise of terrorist interested in security attacks on air traffic, aviation security receives significant attention in the past few years. In 2016, Resolution No. 2309 (2016) was issued by the Security Council to Call for Closer Collaboration to Ensure Safety of Global Air Services and Prevent Terrorist Attacks. Moving forward, Many Aviation security Declarations have endorsed in the AFI and MID Regions such as: Windhoek Declaration on Aviation Security and Facilitation, endorsed on 7 April 2016; Riyadh Declaration on Aviation Security and Facilitation, endorsed on 31 August 2016 in Riyadh, Kingdom of Saudi Arabia; Dubai Declaration on Cyber Security, endorsed on 4 April 2017 in Dubai, United Arab Emirates. Recently, On 24 August 2017, Africa And Middle East Aviation Security Roadmap was adopted to foster Aviation Security in Africa and the Middle East during the Regional Ministerial Conference on Aviation Security in Africa and the Middle East held in Sharm El Sheikh, Egypt.

1.3 As States and industry in MID Region are moving forward, this paper presents a brief overview of the possible security issues regarding using ADS-B, various mitigation of these security issues and the proposed draft ADS-B interference reporting system to be used in the ICAO MID Region.

2. DISCUSSION

Benefits of Using Space-Based ADS-B Compared with Traditional Surveillance Systems

2.1 ADS-B is a surveillance system that periodically broadcast messages containing aircraft identification, position, altitude, velocity and other data which have been determined by on-board airborne sensors. An ADS-B ground system uses a non-rotating antenna positioned within a coverage area, to receive messages transmitted by aircraft. However, unlike radar, the position of the aircraft is determined on the aircraft and transmitted to the ADS-B ground receivers.

2.2 Strengths of ADS-B compared with the traditional surveillance techniques:

- simple ground station design without transmitter;
- high accuracy compared with Primary Surveillance Radar (PSR) and Secondary Surveillance Radar (SSR);
- ADS-B does not have a rotating antenna hence, it has a high update rate (0.5 sec), compared with PSR which updates aircraft position information once every 4 to 5 seconds;
- very low ground station cost;
- higher performance velocity vector measured by avionics and then broadcast, rather than determined from positional data received on the ground;
- accuracy not dependent on range from ground station; and facilitates future provision of complete picture at pilot based on air-to-air ADS-B

Data Security Challenges Associated with Using ADS-B as Main Surveillance System

2.3 Unfortunately, ADS-B is prone to security threats that potential attackers can exploit. These vulnerabilities inherently come from the nature of broadcast surveillance information over known frequency 1090 MHz without encryption mechanism of the data sent.

2.4 There are many forms of security vulnerabilities in ADS-B that can be classified into passive attack and active attacks.

2.5 The most straight forward attack is the act of listening to broadcasted transmissions of ADS-B signal. Where ADS-B protocols send unencrypted messages over standard frequency, 1090 MHz that allows easily detection of aircraft trajectories. Eavesdropping (passive attack) can be easily achieved by using commercially available low-cost ADS-B receivers.

2.6 Active attacks are more sophisticated that could result in severe threats to air traffic safety, and could be based on message injection, message deletion and message modification. Spoofing ATC by injection of ADS-B messages from non-existent or ghost aircraft could be broadcast on ADS-B channels, leading to undesired decisions by ATC or denial of service due to excessive ghost targets in the surveillance system.

Different Mitigation Techniques on Security Threats in ADS-B

2.7 One of the most common techniques used to mitigate security threats in ADS-B is the Multi-sensor data fusion technique. Multi-sensor fusion improve the quality of surveillance track provided to air traffic controllers by integrating data from multiple surveillance sensors to form a single track for each aircraft. A multi-sensor fusion processor may form a surveillance track using inputs from any or all of the following sensors, in areas of overlapping coverage: PSR, SSR, Wide Area Multilateration systems and ADS-B receivers. Also multi-sensor data fusion techniques provide Filtering of anomalous data in which all of the sensor types listed above have the potential to generate anomalous information.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the possible security issues that may arise by using ADS-B;

b) invite ICAO MID Regional Office to revise and adopt the proposed Draft Guidance for ADS-B Interference Reporting to States as at **Appendix A**;

c) encourage States/Organizations to complete the reporting form, to share experience, regarding vulnerabilities of ADS-B signal, within 7 days of the occurrence as recommended, to be regularly disseminated by the ICAO MID office every three months;

d) seek support from the ICAO in organizing Seminars/Workshops to discuss, facilitate and exchange experience among States, for promoting better understanding of data security and planning for implementation of the ICAO Doc 9985 ATM Security Manual; and

e) discuss any relevant matters as appropriate.

APPENDIX A

Guidance for ADS-B interference reporting to States

Originator of this Report	
Organization:	
Department:	
Street / No.:	
Zip-Code / Town:	
Name / Surname:	
Phone No.:	
E-Mail:	
Date and Time of Report:	
Description of Interference	
Degradation of ADS-B Performance:	[ ] Jamming [ ] Complete outage [ ] Spoofing/ wrong surveillance data [ ] other
Problem Duration:	Days, Hours, Minutes, Seconds_____ _____ [ ] continuous [ ] intermittent
Date UTC	
Start Time UTC	
End Time UTC	
Source of Initial Interference Report:	Pilot [ ], Engineer/Technician [ ], Other [ ]
Description / Additional Information	
ADS-B Transponder :	
Ground Station Manufacturer :	
Transponder Message Format :	
Flight level or Altitude at which it was detected:	
Airline Name:	
Aircraft Type and Registration:	
Flight Number:	
Airway/Route flown:	
Coordinates of the First Point of Occurrence / Time (UTC):	UTC: Lat: Long
Coordinates of the Last Point of Occurrence / Time (UTC):	UTC: Lat: Long:
Affected Ground Station [e.g. ADS-B Ground receiver]	Name/Indicator; Lat: Long:

Information on Presumed Source of Interference	
Presumed Location of Interference Source:	Lat/Long: Or Nearest City or Landmark
Interfering Frequency (if known:)	
Signal Strength and Reference Bandwidth: (if known)	
Further Descriptions of the Interference Case:	
Note: Some of the information require coordination with the concerned parties.	

Description of Fields

Date UTC	UTC date when the event occurred.
Time UTC	UTC time (or range of times) at which the event occurred.
Aircraft ID	The ICAO three-letter designator for the aircraft operating agency followed by the flight identification (e.g. KLM511, BAW213, JTR25)
Originator	Point of contact at the originating organization for this report (usually the author).
Organization	The name of the organization (airline, ATS provider or communications service provider) that created the report.
Description/ Additional Information	This should provide as complete a description of the situation leading up to the problem as is possible. Where the organization reporting the problem may not be able to provide all the information (e.g. the controller may not know everything about the transponder,...), it would be helpful if they would coordinate with concerned parties to provide the requested information : ● A complete description of the problem being reported ● The route contained in the FMS and/or flight plan ● Any flight deck indications ● Any indications provided to the controller when the problem occurred ● Any additional information that the originator of the problem report considers might be helpful but is not included on the list above ● Diagrams and other additional information (such as printouts of message logs) may be appended to illustrate the reported problem if considered useful.
ADS-B Transponder	Description on transponder manufacturer, parts number, software version as appropriate
Transponder Message Format	DO260, DO260A,....
Ground Station Manufacturer	Ground Station Manufacturer, model number and software version as appropriate (sometimes it is difficult to determine if the problem is airborne equipment or ground station equipment)
Registration	Registration number (tail number) of the concerned aircraft
Aircraft Type	The aircraft type designator of the aircraft as specified in Doc 8643

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