International Civil Aviation Organization

MIDANPIRG Communication, Navigation and Surveillance Sub-Group

Thirteenth Meeting (CNS SG/13)
(Jeddah, Saudi Arabia, 20 – 23 October 2024)

Agenda Item 5: CNS Planning and Implementation Framework in the MID Region Surveillance Matters

INTEGRATING ADS-B COVERAGE AS A COMPLEMENTARY AND SECOND SURVEILLANCE LAYER TO RADARS MODE S SURVEILLANCE SYSTEMS

(Presented by Saudia Arabia)

SUMMARY

Saudi Arabia is implementing the ADS-B ground surveillance system compliant with the DO-260A/B standards, which will be completed by Q2 2025, to enhance and expand the coverage of air traffic services surveillance within Jeddah FIR in addition to the current Surveillance facilities used for air traffic management. The Air traffic services surveillance systems integrated to the ATM System include conventional radar systems providing basic tracking capabilities and Mode S, which improves radar efficiency through selective interrogation of aircraft. Despite their effectiveness, these systems have limitations regarding coverage, infrastructure, operating costs, and deployment constraints in remote areas. ADS-B broadcasts an aircraft's identification, position, altitude, velocity, and other information using Global Navigation Satellite System (GNSS) technology, which significantly improves surveillance coverage, especially in remote and oceanic airspace.

Action by the meeting is in Paragraph 5 of this WP.

REFERENCE(S)

- ICAO Annex 10
- ICAO Doc 9750, Global Air Navigation Plan (GANP)
- MIDANPIRG/19 Report

1. INTRODUCTION

1.1 The evolution of air traffic management (ATM) is critical in addressing the growing demands of global air travel. Automatic Dependent Surveillance-Broadcast (ADS-B) has emerged as a transformative technology that complements existing surveillance methods. This working paper discusses integrating ADS-B coverage as a complementary and second layer with conventional radars and Mode S surveillance systems. It aims to extend the coverage, enhance situational awareness, operational efficiency, and safety within the ATM framework, with a particular emphasis on how air traffic controllers (ATCs) can effectively utilize this integration, taking into account, the differing position update rates for ADS-B and Mode S systems.

2. DISCUSSION

The benefits of Integrating ADS-B with Conventional and Mode S radars surveillance Systems can be summarized as follows:

Enhanced Coverage: ADS-B extends surveillance coverage and capabilities beyond the limits of conventional radars, providing comprehensive coverage in remote areas where radar may be sparse, thereby reducing gaps in air traffic monitoring.

Improved Data Accuracy: ADS-B provides more frequent and accurate position updates, allowing Air Traffic Controllers to monitor and manage aircraft with significantly enhanced situational awareness.

Increased Data Availability and Quality: By integrating ADS-B data with conventional radar and Mode S information, Air Traffic Controllers gain access to richer datasets and information, resulting in improved situational awareness, and decision-making.

Operational Efficiency and Cost-Effectiveness: The use of ADS-B can reduce reliance on costly ground infrastructure, leading to a more efficient and economically viable means for ATS surveillance.

Safety Enhancement: The additional layer of surveillance generated by ADS-B stations to enhance the current capabilities of surveillance and safety levels as it will ensure accurate air situation display and application of ATC separation using redundant surveillance data.

2.1 Operational Reliance on ADS-B for ATC service

Cross-Verification of Aircraft Positions: Air Traffic Controllers can use ADS-B information to cross-check positions reported through Mode S systems. The higher update rate of ADS-B data allows controllers to confirm real-time identity and position accuracy more frequently, enhancing trust in the data being processed, and presented.

Increased Update Frequency: The rate of updates provided by ADS-B (every second) substantially reduces the latency in situational awareness compared to Mode S, where updates may occur every 4 to 12 seconds. This difference is crucial for air traffic controllers within airspace where reduced separation is applied (5NM) and changes to operational context, such as terminal airspace and high-traffic scenarios, where timely information is vital to maintain safety.

Enhanced Conflict Management: With the higher updates of ADS-B data, air traffic controllers (ATCOs) can identify and resolve potential conflicts earlier, improving the safety of air traffic management. ADS-B data enables air traffic controllers to identify conflicting trajectories and intervene proactively, significantly lowering the risk of separation breaches.

Support during Interrogation Failures: In cases where Mode S interrogations fail (e.g., due to equipment malfunction or aircraft transponder issues), ADS-B ensures that air traffic controllers can continue to effectively manage the traffic without interruptions, providing an additional layer of reliability for ATS surveillance.

2.2 Risks Associated with RFI and Unavailability of GNSS Signals

Impact of Jamming and Loss of GNSS signals: The reliance on ADS-B and GNSS for position determination introduces risks of losing the identities and positions of traffic due to GNSS vulnerabilities, particularly with respect to GNSS RFI. The loss of GNSS signals can severely affect

the accuracy and reliability of the aircraft's reported positions, leading to:

Loss of Position Information: Without GNSS signals, ADS-B cannot accurately broadcast the aircraft's position, impairing Air Traffic Controllers 's ability to monitor and manage aircraft effectively.

Increased Risk of Incidents: In cases of unreliable position data, the risk of loss-of-separation incidents between aircraft increases, compromising ATM's overall safety.

Operational Disruptions: A significant disruption in GNSS signals can lead to operational inefficiencies, delays, with a need to revert to other surveillance methods.

GNSS vulnerabilities and RFI: GNSS RFI can occur due to various factors, including malicious intent. Such disturbances necessitate implementing robust security measures and backup navigation systems to mitigate risks associated with disruptions.

3. RECOMMENDED ACTIONS

3.1 The meeting may wish to consider the following mitigation actions and Regulatory framework Considerations:

Mitigation Strategies

i. **Risk Mitigation Strategies**: Establish processes to address the potential risks of GNSS loss, including contingency plans that outline procedures for Air Traffic Controllers to follow in the event of signal loss or jamming events.

ii. **Standardization of Data Formats and Interoperability**: ICAO should develop and promulgate guidelines for interoperability between ADS-B, Mode S, and conventional systems, focusing on compatibility (efficient utilization of provided data) and data exchange standards (Privacy & Data integrity).

Regulatory framework Considerations

i. **Framework for Security Requirements**: Establish comprehensive guidelines to safeguard the integrated surveillance systems against potential cybersecurity threats, including regular assessments and incident response plan.

ii. **Continuous Monitoring and Performance Evaluation**: Implement monitoring mechanisms to assess the effectiveness and reliability of the integrated surveillance systems, allowing for iterative improvements based on feedback and recorded performance data.

4. CONCLUSION

4.1 The meeting may wish to note that the integration of ADS-B as a complementary layer to the conventional and Mode S surveillance systems represents a significant enhancement in air traffic management. By leveraging the strengths of each surveillance technology, the ANS service provider can provide air traffic controllers with a more robust resource for ensuring safe and efficient airspace operations. Moreover, understanding the operational benefits arising from differing position update rates enables Air Traffic Controllers to better manage air traffic volume in today's complex aviation environment.

5. ACTIONS BY THE MEETING

5.1 The meeting is invited to:

a) note the information provided in this paper;

b) review the Risks and recommendations associated with usage of ADS-B as complementary/second layer for ATS surveillance as outlined in this working paper; and

c) support the development of guidelines and best practices for integrating ADS-B as a complementary system to conventional and Mode S surveillance within the ATM ecosystem, considering risks related to GNSS vulnerabilities.

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