



ICAO

International Civil Aviation Organization

**Sixth Meeting of the Surveillance Implementation
Coordination Group (SURICG/6)**

Video Teleconference, 24 – 27 August 2021

Agenda Item 8: Update on surveillance activities and explore potential cooperation opportunity

c) Aircraft Manufacturers and Avionics Suppliers

RTCA STANDARDS SUPPORTING GLOBAL INTEROPERABILITY

(Presented by RTCA)

SUMMARY

This paper presents the work on RTCA activities developing internationally harmonized surveillance standards (in cooperation with EUROCAE) since 3rd quarter 2020.

1. INTRODUCTION

1.1 RTCA is a private, not-for-profit association founded in 1935 as the Radio Technical Commission for Aeronautics, now referred to simply as “RTCA”. Headquartered in Washington, DC, RTCA acts as a Standards Development Organization (SDO) with a mission to the assist in the creation and implementation of integrated performance standards that meet the changing global aviation environment and ensure the safety, security, and overall health of the aviation ecosystem.

1.2 RTCA works with the Federal Aviation Administration (FAA) to develop comprehensive, industry-vetted and endorsed standards that can be used as means of compliance with FAA regulations. Our deliberations are open to the public and our products are developed by aviation community volunteers functioning in a consensus-based, collaborative, peer-reviewed environment.

1.3 RTCA works collaboratively with EUROCAE to develop internationally harmonized standards for the aviation industry, and our standards are often used as a means of compliance for regulatory certification of equipment.

2. DISCUSSION

2.1 RTCA works collaboratively with EUROCAE to develop internationally harmonized standards.

2.2 In January of 2016 a committee structure called the Combined Surveillance Committee (CSC) was created. The CSC is made up of RTCA and EUROCAE committees working on ADS-B and Mode-S technologies and includes members from RTCA SC-186, RTCA SC-209, EUROCAE WG-49, and EUROCAE WG-51.

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2.3 This IP outlines the documents updated by the CSC since September of 2020. While not all of these efforts will be of interest to the international community, they are offered here for the panel's information.

2.4 In December of 2020 RTCA and EUROCAE jointly published three documents relating to surveillance technology: DO-260C/ED-102B (ADS-B); DO-361A Change 1/ED-236A Change 1 (Flight-deck Interval Management (FIM) Change 1); DO-181F and ED-73F Mode-S Transponder.

2.5 DO-260C/ED-102B is the 1090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services-Broadcast (TIS-B) MOPS

2.5.1 Initially, the ADS-B MOPS was opened to support the ADS-B Interval Management (IM) Application along with known required changes from DO-260B, but many other capabilities (see Appendix A) were added along the way including

- Collision Avoidance
- Meteorological Data
- UAS
- Commercial Space/Hypersonic and High Altitude Vehicles
- 1030/1090 MHz RF Monitoring
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2.5.2 Phase overlay was introduced as an optional component in the ADS-B MOPS as all supported data for version 3 is directly supportable in the standard PPM maximum squitter rate. Phase Overlay was introduced so that industry can begin producing equipment that can readily incorporate it as this will be the method for additional 1090ES data link capacity.

2.6 DO-361A Change 1/ED-236A Change 1 includes updates, corrections, and additional materials to support implementation of the Flight-deck Interval Management (FIM) MOPS. The largest of these is the inclusion of Test Vectors and related supplemental material.

2.6.1 This Change 1 affected the original DO-361A/ED-236A document that was published in March 2020. DO-361A/ED-236A support the Interval Management (IM) Application when implemented together with the Basic Airborne Situational Awareness (AIRB) application as defined in the ASA MOPS RTCA DO-317C / EUROCAE ED-194B.

2.6.2 An IM Operation, employed by a controller, has flight crews follow speed guidance to achieve, capture, and/or maintain a given spacing from Designated Traffic through the use of the on-board FIM Application. During an IM Operation, the controller will maintain the same responsibilities as they would during non-IM Operations.

2.7 DO-181F/ED-73F (also published in December of 2020) is the Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment MOPS.

2.7.1 The MOPS removed Level 1 transponder description and supports the restructuring of the Level 2 transponder description to eliminate unused Mode S protocols and interfaces.

2.7.2 It supports minimum Mode S transponder standard for international civil air traffic and clarifies that Overlay Command Capability (OVC) is required for Level 2 Transponders.

2.7.3 The document also removed unnecessary DO-181E functions (Mode A/C/S All-Call Interrogations and Replies) and moved 1090ES requirements to DO-260C/ED-102B.

2.7.4 Updates to existing TCAS standards, requirements to accommodate ACAS X standards, several new optional features and availability related items, and updates to several registers were also included.

2.8 RTCA and EUROCAE are beginning work on the development of DO-260C/ED-102B Change 1 and DO-181F/ED-73F Change 1. The work will be completed this autumn with expected publication in December of 2021. These change documents will address and correct issues that have been identified since the publishing of the original documents.

2.9 RTCA (EUROCAE is not participating in this effort) has undertaken an update of DO-282B Minimum Operational Performance Standards (MOPS) for Universal Access Transceiver (UAT) Automatic Dependent Surveillance Broadcast (ADS-B). While this update will be of little interest to most states other than the United States, it is included here for completeness.

2.9.1 The update to DO-282B includes changes necessary to align the document and requirements therein with changes that are already incorporated into DO-260C. There will also be a review and correction of issues that have been identified since the publishing of UAT ADS-B MOPS (DO-282B)

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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Appendix A – Details of Updates

A.1 The items below are more detailed explanations of the updates to the documents that have occurred in the past year.

A.2 Interval Management (IM)

- Added broadcast of additional weather parameters (wind and temperature – see section 2.4.2)
- Receiver Improvements made in order to support IM
 - Advanced range receiver to support longer range performance
 - Track initiation enhancements to improve track acquisition
 - Time to initiate tracks for surface traffic reduced by simplifying position decode
 - Time to initiate tracks for airborne traffic reduced by use of velocity information
 - Enhancements were made to the track file maintenance to prioritize IM traffic as needed
 - 3 track IDs were reserved to prevent removal due to automatic range filtering
 - Uniform distribution of (even/odd) squitter formats
- Mode S transponders supporting ADS B version 3 also include IM data registers which can be extracted by Ground Secondary Surveillance Radar interrogations

A.3 Aircraft-Derived Weather Data

- The data will support applications such as IM, wake vortex avoidance and surfing, hazardous weather detection and avoidance, and weather forecasting
- The requirements were derived from RTCA DO-364 (Aeronautical Information/Meteorological Data Link Services), which built on previous work from RTCA, World Meteorological Organization, and ICAO Annex 3
 - Two new optional periodic AIREP Messages (Aircraft State & Weather State) were added
 - Aircraft State, if provided, includes: aircraft configuration, ICAO aircraft type, gross weight, and wingspan
 - Weather State, if provided, can include either:
 - icing status; wind quality, wind speed and direction, air temperature, and airspeed OR
 - icing status (optional), roll angle, heading, air temperature, and airspeed
 - Additional weather data added to an existing 1090ES Aircraft Status Message
 - Eddy Dissipation Rate (EDR) and Water Vapor
- ADS-B version 3 also supports broadcast of pilot-observed flight weather [Pilot Reports (PIREPs)] with 3 new on-condition messages
 - Flight Weather
 - Temperature, Wind, and Turbulence
 - Hazardous Weather

A.4 UAS

- ADS-B version 3 includes ability to broadcast a UAS/RPAS lost link condition
- This emergency condition will be reported and made available via ADS-B and Mode S replies and may be used to initiate appropriate contingency procedures

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- When in the lost link condition, the UAS/RPAS can broadcast its contingency plan, identifying the course of action the UAS/RPAS is following
- For all aircraft types, ADS B version 3 provides an indication of whether the aircraft is conducting manned or unmanned operations

A.5 Commercial Space/Hypersonic Vehicles

- ADS-B version 2 and earlier cannot reliably support:
 - horizontal velocities above 1,000 knots
 - altitudes above 130,000 feet
 - vertical velocities above 32,500 feet per minute
- ADS-B version 3 accommodates the higher velocities and altitudes
 - Horizontal and vertical velocities consistent with a Space Shuttle launch profile can be reported
 - Altitudes up to 1 Million feet can be reported

A.6 Airborne Collision Avoidance System (ACAS X)

- Transponder changes were made to ensure that Resolution Advisory coordination messages are given priority over other data provided to the ownship ACAS
- Transponder changes were made to improve the availability of coordination data received over the RF link and provided to the ownship ACAS
- Resolution Advisory reporting by the transponder incorporates additional data from collision avoidance systems which provide both vertical and horizontal resolution capability, such as ACAS X_U for unmanned aircraft
- Addition of ADS-B subfields to
 - enable Detect & Avoid (DAA) systems to receive ACAS coordination data
 - support future ACAS coordination capabilities

A.7 1090 MHz Frequency Conservation

- Removal of replies to Mode A/C/S All-Call interrogations
- Additionally, transponder reply-rate limiting is improved to minimize loss of surveillance and ACAS function in high-density airspace
- New functions to report a transponder in reply-rate limiting and ADS-B Transmit Power indication
- Interrogation/Reply Monitor (IRM) data has been incorporated as an optional reporting feature
 - This will improve 1030/1090 MHz spectrum monitoring and assist in the protection of aeronautical surveillance and collision avoidance system performance
 - IRM data includes measurement of transponder interrogation and reply rate activity from equipped aircraft
- Phase Overlay technique, which provides additional data within existing messages, is specified
 - Although Phase Overlay is optional in DO-260C/ED-102B, it is introduced so that industry can begin producing and testing equipment that can readily incorporate the capability
 - ADS-B Phase Overlay Support includes
 - Airborne and Surface messages which include full state and status in single extended squitter
 - IRM messages which provide additional detail on minimum and maximum rates

- Mode S Phase Overlay Support includes
 - Additional Mode S register data in the Mode S replies to GICB extractions

A.8 Air Ground Reporting

- ADS-B version 3 enhances requirements for selection of airborne or surface message formats to transmit
- These improvements are meant for fixed-wing aircraft without an automatic means of determining on the ground status (e.g., a landing gear weight on wheels switch)
- These requirements resulted from FAA monitoring showing that a significant number of aircraft do not reliably report on-the-ground status, which reduces effectiveness and safety associated with ADS-B traffic applications

A.9 Surface Reporting Improvements

- ADS-B version 3 supports the ability to report availability of FAA's Same-Link-Rebroadcast service, thereby potentially enabling ADS-B surface alerting applications on-board aircraft
- To enable more accurate position determination on the airport surface by multilateration systems, ADS-B version 3 includes transponder antenna offset information
- To improve tracking of aircraft/vehicles operating on the surface, ADS-B version 3 modifies the surface squitter transmission requirements

A.10 Autonomous Distress Tracking (ADT)

- Aircraft delivered after January 1, 2021 must automatically transmit aircraft position at least once per minute when the aircraft is in distress
- ADS-B has always provided aircraft position; version 3 provides a means to initiate broadcast of 'aircraft in distress' to satisfy the ICAO requirement

A.11 Miscellaneous Fixes

Additional fixes and updates that allowed for improvements in the ADS-B system included

- Corrected handling of aircraft identification data which can result in a potential difference between aircraft identification data received via ADS-B and ground interrogators
- New ADS-B information to support avionics debugging
 - Active transponder side indication
- Level 2 Transponders redefined to eliminate unused data link functions
 - This becomes a new ICAO minimum Mode S transponder standard for international civil air traffic
 - Data link functions are now optional for a Level 2 transponder since they are currently not utilized. Future use is limited due to spectrum concerns
- Revised Emitter Category encodings
 - clarified that intended use is solely as an aid to visual acquisition