International Civil Aviation Organization
North American, Central American and Caribbean Office

WORKING PAPER

ADS-B/LEG — WP/05
09/11/18

Automatic Dependent Surveillance – Broadcast (ADS-B) Implementation and Regulation Meeting for the NAM/CAR/SAM Regions (ADS-B/LEG)

Mexico City, Mexico, 26 to 30 November 2018

Agenda Item 4: **Technical and operational requirements required for the ADS-B implementation**

4.1 Operational Procedures

Major considerations when contemplating ADS-B implementation

(Presented by the United States)

EXECUTIVE SUMMARY	
This paper outlines the major topics/concepts that should be considered by any ICAO State that is contemplating the use of ADS-B as an "ATS surveillance system" (per ICAO Doc 4444, PANS-ATM).	
Action:	Suggested action is presented in Section 4.
Strategic Objectives:	• Safety • Air Navigation Capacity and Efficiency
References:	• ICAO Doc 4444, PANS-ATM • ICAO Circular 326 • TSO/ETSO-C166b (based on DO-260B/ED-102A) • FAA Advisory Circular 20-165 (latest revision) • EASA CS-ACNS (latest revision) • Safety, Performance, and Interoperability Requirements Document for the ADS-B Non-Radar-Airspace (NRA) Application, DO-303/ED-126 • Safety, Performance, and Interoperability Requirements Document for Enhanced Air Traffic Services in Radar-Controlled Areas Using ADS-B Surveillance (ADS-B-RAD), DO-318/ED-161 • ASTERIX CAT021 Specification (https://bit.ly/2PoRbSS)

1. Introduction

1.1 The FAA's current ADS-B Program was launched in 2007. One of the first actions taken by the FAA program manager was to understand what other ICAO States were doing or planning. After consultations, the FAA, NavCanada, AirServices Australia, and EUROCONTROL ADS-B implementation program managers began a series of regular meetings; the primary purpose of these meetings was to coordinate program activities as much as possible given the different objectives and environments of each program. These meetings, along with FAA participation in various ICAO regional ADS-B/Surveillance implementation forums, have given the FAA a broad perspective on the different ways that ADS-B is being used by Air Navigation Service Providers (ANSPs) worldwide.

1.2 This paper outlines the major topics/concepts that should be considered by any ICAO State which is planning to use ADS-B as an "ATS surveillance system" (per ICAO Doc 4444, PANS-ATM).

2. Discussion

2.1 ADS-B data includes Quality Indicators in each ADS-B squitter. ANSP personnel must be cognizant of the ADS-B Quality Indicator requirements for different separation standards since the available quality indicators have changed with each ADS-B version (Version 0 based on DO-260; Version 1 based on DO-260A; and Version 2 based on DO-260B). See ADS-B/LEG — IP/02 for more details on the different ADS-B versions. Additionally, ANSP personnel must be aware that ADS-B Quality Indicator values of "0" (zero) communicate that the associated ADS-B data should not be used; and that this requirement must be enforced in any ATC automation system using ADS-B data.

2.2 ICAO Circular 326 is the primary ICAO reference document for using ADS-B data as an ATS surveillance system. In part, it states that ADS-B surveillance can be used to provide a 2.5 NM, 3 NM or 5 NM separation minima as prescribed in PANS-ATM with ADS-B as the ATS surveillance system, provided that a region or State has previously undergone a safety assessment demonstrating that the intended safety level will be met using ADS-B. In general, an analysis must be performed which defines what ADS-B Quality Indicator values are required to provide equivalent or better surveillance performance to a reference radar supporting a given separation minima. Note that a key limitation of Circular 326 is that it was written before ADS-B Version 2 (DO-260B/ED-102A, which are invoked by TSO/ETSO-C166b) avionics standards were finalized and also before publication of key ADS-B Out installation guidance by the U.S. and the E.U. (FAA Advisory Circular 20-165 and EASA CS-ACNS). The ICAO Surveillance Panel plans to produce a Manual to update and supersede the information in Circular 326 in the future.

2.3 RTCA and EUROCAE jointly produced two documents that provide relevant information on ADS-B Quality Indicator requirements, as they were developed as part of the preparations for U.S. and European ADS-B rulemaking activities:

a) Safety, Performance, and Interoperability Requirements Document for the ADS-B Non-Radar-Airspace (NRA) Application, DO-303/ED-126; and
b) Safety, Performance, and Interoperability Requirements Document for Enhanced Air Traffic Services in Radar-Controlled Areas Using ADS-B Surveillance (ADS-B-RAD), DO-318/ED-161.

DO-318/ED-161 includes the analysis which formed the basis for the ADS-B Quality Indicator requirements (NACp, NACv, NIC, SIL and SDA) in U.S. 14 CFR 91.227.

2.4 Airport surface surveillance systems using ADS-B data should also automatically check ADS-B Quality Indicator values and ignore ADS-B data with Quality Indicators not meeting the required values for its use. For example, in systems providing runway incursion alerts, the reported ADS-B position accuracy (NACp) must be sufficient to allow the alerting algorithm to resolve whether an aircraft is on a runway or a nearby taxiway. If not, the "nuisance alert" rate may be high and tower controllers may find such alerts not operationally suitable.

2.5 ANSPs planning to use the All-purpose structured EUROCONTROL surveillance information exchange (ASTERIX, https://www.eurocontrol.int/services/asterix) Specification known as CAT021 to provide ADS-B data from ADS-B ground stations to ATC automation, must be aware that different editions of the CAT021 specification are available. It is important for ANSP system implementers to understand what CAT021 edition(s) their ADS-B ground stations are capable of outputting and which CAT021 edition(s) can be accepted by the ATC automation systems. Early CAT021 editions were aimed at providing ADS-B Version 0 (DO-260/ED-102) data to ATC automation systems. For example, Australia's ATC automation system has used CAT021 Edition 0.23 for many years. These early CAT021 editions cannot process the additional message elements contained in ADS-B Version 2. Therefore, although an ADS-B ground station may be capable of receiving and decoding ADS-B Version 2, all information received may not reach the ATC automation system, depending on which CAT021 edition is in use.

2.6 CAT021 Edition 2.1 is the first edition to support the message elements in ADS-B Version 2

DO-260B/ED-102A - One State using this edition is Singapore; Australia's new ATC automation system will support CAT021 Edition 2.1 or later. Note that Editions 2.2 and later are not backwards compatible to previous CAT021 editions; Edition 2.4 (June 2015) is the latest release.

2.7 In airspace where ADS-B data is used to provide ATS surveillance services, it is important to provide a capability for monitoring ADS-B data from aircraft. Such ADS-B monitoring is important for both ANSP service provision and the State regulator's compliance activities. Various approaches exist for recording and storing the data for monitoring, including:

a) all Mode S Downlink Format (DF) messages
b) ADS-B data in ASTERIX messages
c) track parameters of interest (e.g., ADS-B Position Accuracy, Vertical Rate, Flight Level)

Note that this approach is only useful for ADS-B data monitoring if ADS-B data provides the sole surveillance source for ATC automation tracks.

2.8 Once the data is recorded and stored, various methods can be used to perform "monitoring":

a) controller reporting (a controller report initiates an investigation)
b) data post-processing tools (initiated periodically by a human)
c) automated data post-processing (continuous)

The method chosen must align with State regulator requirements and the ANSP resources available to support the monitoring approach.

3. Conclusion

This paper outlined the major topics/concepts that should be considered by any ICAO State that is contemplating the use of ADS-B as an "ATS surveillance system" (per ICAO Doc 4444, PANS-ATM).

4. Actions on the meeting

4.1 The States are invited to:

a) Carefully consider this information when considering what regulations are necessary for ADS-B.

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