



The European Organisation for Civil Aviation Equipment
L'Organisation Européenne pour l'Équipement de l'Aviation Civile

ADS-B APPLICATION INTEROPERABILITY REQUIREMENTS FOR VDL MODE 4

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FOREWORD

- 1 The document ED-156A “ADS-B Application Interoperability Requirements for VDL Mode 4” was prepared by EUROCAE Working Group 51 and was accepted by the Council of EUROCAE on 19 March 2010.
- 2 EUROCAE is an international non-profit making organisation. Membership is open to manufacturers and users in Europe of equipment for aeronautics, trade associations, national civil aviation administrations and non-European organisations. Its work programme is principally directed to the preparation of performance specifications and guidance documents for civil aviation equipment, for adoption and use at European and world-wide levels.
- 3 The findings of EUROCAE are resolved after discussion among its members and, where appropriate, in collaboration with RTCA Inc, Washington D.C. USA and/or the Society of Automotive Engineers (SAE), Warrendale, PA, USA through their appropriate committee.
- 4 The document represents “ADS-B Application Interoperability Requirements for VDL Mode 4”.
- 5 EUROCAE performance specifications are recommendations only. EUROCAE is not an official body of the European governments; its recommendations are valid statements of official policy only when adopted by a particular government or conference of governments.
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CHAPTER 1

INTRODUCTION

1.1 DOCUMENT PURPOSE

This document needs to be used in conjunction with the Safety, Performance and Interoperability Requirements document for ADS-B Applications. It provides a supplement that defines the requirements for ADS-B-application interoperability to be achieved using VDL Mode 4. The requirements contained in this document provide assurance that a VDL Mode 4 system will perform the intended function in an acceptably safe manner for the operations defined in the OSEDs for the various applications.

These requirements can be used for approval processes including aircraft type design approval, and operational approvals for aircraft operators and Air Traffic Services Providers (ATSP).

1.2 DOCUMENT CONTENTS

Chapter 2 provides general information on VDL Mode 4 supporting ADS-B.

Chapter 3 demonstrates how VDL Mode 4 meets the requirements of the ADS-B-NRA application.

CHAPTER 2

GENERAL INFORMATION ON VDL MODE 4 SUPPORTING ADS-B

2.1 INTRODUCTION

The VDL Mode 4 data link is intended for use for air-ground (A/G) and air-air (A/A) data communications operating in the VHF band, using Gaussian-filtered Frequency Shift Keying (GFSK) Modulation with 25 kHz channel spacing. The system is defined in ICAO VHF Digital Link (VDL) Standards and Recommended Practices (SARPs), ICAO Doc 9816. VDL Mode 4 airborne equipment specifications are contained in Eurocae document ED-108A¹. The VDL Mode 4 Ground equipment standards are contained in ETSI European Norm 301 842.

VDL Mode 4 is developed for Communications, Navigation, and Surveillance (CNS/ATM) aviation applications, including broadcast applications (e.g. ADS-B) and point-to-point communications (e.g. ADS-C, CPDLC). VDL Mode 4 protocols support ADS-B and similar broadcast applications through the broadcast of short repetitive messages, with graceful adaptation to increasing traffic loads.

VDL Mode 4 is built on the Self-organizing Time Division Multiple Access (STDMA) concept, in which the time slots are synchronized to UTC, and stations advertise their intention to transmit in a specified time slot by means of a reservation protocol carried in a prior transmission. A group of contiguous time slots spanning a period of 60 seconds is defined as a superframe. Each time slot may be used by a radio transceiver (mounted on an aircraft, on ground vehicles or at fixed ground stations) for the transmission of data. The exact timing of the slots and the planned use of them for transmissions are known to all users in range of each other, so that efficient use of the data link can be made and users do not transmit simultaneously. As a result of this 'self-organizing' protocol, VDL Mode 4 is capable of operating outside the coverage of a ground infrastructure and can therefore support air-air as well as ground-air data communications and applications. In high density airspace, a ground infrastructure may be used to manage the system and improve overall performance.

2.1.1 Channel management

One or more 25 kHz VHF channels between 118.00 and 136.975 MHz may be used for the VDL Mode 4 data link. Two universally agreed GSC (Global Signalling Channels), supplemented by LSC (Local Signalling Channels) if needed, are intended to be used to support ADS-B and other services.

The number of channels required to support VDL Mode 4 services in a certain area will depend on regional and local conditions, such as traffic density (which affects the channel load), certification requirements, ATS regulations and spectrum availability.

Authorized ground stations may transmit a Directory of Services (DoS) on the Global Signalling Channels to define the frequencies and associated operations available in the local domain.

¹ Airborne equipment standards are also contained in ETSI European Norm 302 842.

2.1.2 Broadcast synchronization burst messages

VDL Mode 4 supports the ADS-B function through the use of the synchronization burst message. This message consists of a 'fixed' part containing information required for communications maintenance as well as basic ADS-B information, and a 'variable' part containing additional information required by the applications. The following variable parts are defined:

- Basic Ground,
- UTC Time,
- Single slot TCP (Trajectory Change Point),
- Aircraft data,
- High Dynamic,
- Basic,
- Full position,
- Two slot TCP (Trajectory Change Point),
- High resolution, and
- Single-slot SVQ (State Vector and Quality).

2.2 GROUND STATION MANAGEMENT

Ground station management is not required for autonomous operation of ADS-B in en-route and uncontrolled airspace, but will typically be required for aircraft in terminal area airspace and for aircraft and ground vehicles at major airports.

In a minimum configuration, the role of a ground station may be restricted to that of a passive receiver of ADS-B reports. Such ground stations would not make their own transmissions and would not have channel management capabilities. This could be a typical situation in remote low-density airspace. Other ground stations will be able to send several types of message to mobiles, including the following:

Messages supporting ADS-B operations:

- Ground station ADS-B transmissions, used for communication management and the ADS-B service;
- Directory of Services (DoS) messages, used to provide information about the VDL Mode 4 services available on different channels;
- Channel management messages, used to instruct an aircraft to change its reporting characteristics (reporting rate, channel, autonomous/directed reporting, and specific synchronisation burst variable part) or to instruct it to transmit specific periodic or on-demand airborne parameters (DAP) information.
- ADS-B Request messages, used to request that an aircraft transmits an ADS-B report consisting of a synchronization burst with specific variable parts depending on whether the aircraft is moving or stationary

Optional messages:

- Blocking messages, used to reserve a series of slots for exclusive use by a ground station in order to protect the transmitted information from unintentional interference from other transmitters;
- TIS-B messages, used by the ground system to re-broadcast position information of non-equipped mobiles to VDL Mode 4 users.

All of the above transmissions are broadcast messages with the exception of the General Request message, which is addressed to a particular mobile station.