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Minimum Operational Performance Standards (MOPS) for Flight Information Services - Broadcast (FIS-B) with Universal Access Transceiver (UAT)

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FOREWORD

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1 PURPOSE AND SCOPE

1.1 Introduction

This document contains Minimum Operational Performance Standards (MOPS) for Flight Information Services – Broadcast (FIS-B) system with Universal Access Transceiver (UAT). These standards specify system characteristics that should be useful to designers, manufacturers, installers and users of the equipment.

Compliance with these standards is recommended as one means of assuring that the equipment will perform its intended function(s) satisfactorily under all conditions normally encountered in routine aeronautical operation. Any regulatory application of this document is the sole responsibility of appropriate governmental agencies.

This document considers an equipment configuration consisting of the airborne processing and cockpit display of aeronautical and meteorological data known as FIS-B provided by the Federal Aviation Administration (FAA).[1] Functions or components that refer to equipment capabilities that exceed the stated minimum requirements are identified as optional features.

Section 1 of this document provides information needed to understand the rationale for equipment characteristics and requirements stated in the remaining sections. It describes typical equipment operations and operation goals, as envisioned by the members of Special Committee 206 (SC-206), and establishes the basis for the standards stated in Section 2. Definitions and assumptions essential to proper understanding of this document are also provided in this section.

Section 2 contains the minimum performance standards for the equipment. These standards specify the required performance under standard environmental conditions. Also included are recommended bench test procedures necessary to demonstrate equipment compliance with the stated minimum requirements.

Section 3 describes the performance required of installed equipment. Tests for the installed equipment are included when performance cannot be adequately determined through bench testing.

Section 4 contains a description of the relationship between the aircraft characteristics and the FIS-B equipment conforming to this MOPS.

Section 5 lists the members of SC-206 who developed the document.

APPENDIX A, a normative appendix, provides formatting and encoding details of FIS-B Uplink Products, including the UAT Ground Uplink Message formatting, the Application

[1] The FIS-B service is part of the FAA's Surveillance and Broadcast Services System (SBSS).

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Protocol Data Unit (APDU) header formatting and encoding, as well as each FIS-B product report in both textual and graphical representations, as applicable, as well as the Current Report List (CRL) with header and payload encoding.

APPENDIX B, an informative appendix, gives the definition of a FIS-B report, describes the components of the FIS-B report, describes the FIS-B report relationship to the APDU that conveys it and provides guidance for identifying redundant FIS-B reports.

APPENDIX C, an informative appendix, provides the update and transmission intervals for each FIS-B product uplinked.

APPENDIX D, an informative appendix, provides background information on the tiered approach used for assigning channel resources to each of the radio stations in the ground network.

APPENDIX E, an informative appendix, gives background on the processing of the Next-Generation Weather Radar (NEXRAD) sensor data for uplink.

APPENDIX F, an informative appendix, gives some background on the approach used within the FIS-B radio station in generating and uplinking the CRL.

APPENDIX G, an informative appendix, describes the process used by the radio stations to transmit in their assigned channels.

APPENDIX H, an informative appendix, gives rationale for not processing the uplink of Special Use Airspace (SUA) product #13.

APPENDIX I, an informative appendix, specifies an acceptable time-based method for an "all-at-once" update of the NEXRAD and Lightning images on the cockpit display.

APPENDIX J, an informative appendix, describes some potential evolution of the FIS-B ground system with the intent to motivate manufacturers to provide some mechanism for field updateability of the FIS-B avionics.

APPENDIX K, an informative appendix, provides a mapping of "shall" requirement numbers to FIS-B Equipment Classes.

APPENDIX L, an informative appendix, describes the calculation of the reference radio station Reception Success Rate (RSR) and provides an example calculation.

APPENDIX M includes the Change Suggestion Form.

The word "equipment" as used in this document includes all components and units necessary for the system to properly perform its intended function(s). For example, the "equipment" may include a processor that receives packetized data ported from the UAT, reassembles and then displays that selectable information on the flight deck. In the case of this example, all of the foregoing components and units comprise the "equipment." It should not be inferred from this example that each FIS-B design will necessarily include all of the foregoing components or units. This will depend on the specific design chosen by the manufacturer.

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This MOPS applies to a specific defined function. The equipment may have additional features related to that function for which there is no specified minimum performance requirement. For example, FIS-B products may be displayed in alternative ways as part of value-added services. Equipment may also have additional functions for which other MOPS or Technical Standard Orders (TSOs) may be applicable or it may contain additional functions not defined by any MOPS or TSO.

If the equipment implementation includes a computer software package, the guidelines contained in RTCA Document (DO)-178()[2]/European Organisation for Civil Aviation Equipment (EUROCAE) European Document (ED)-12(), *Software Consideration in Airborne Systems and Equipment Certification*, should be considered.

If the equipment implementation includes electronic hardware, the guidelines contained in RTCA DO-254()/EUROCAE ED-80(), *Design Assurance Guidance for Airborne Electronic Hardware*, should be considered.

1.2 System Overview

The FIS-B service provides meteorological (MET) and aeronautical data to the cockpit. Figure 1-1 illustrates the high-level data flows supporting FIS-B. The FIS-B Servers located in Regional Control Stations (RCSs) process FIS-B meteorological and aeronautical data. There are three RCSs, which handle FIS-B processing within the 48 Contiguous United States (CONUS), and other RCSs handle FIS-B processing for Guam, Hawaii, and Alaska. The FIS-B input to RCSs consist of FIS-B product data, and the FIS-B output from RCSs is the FIS-B data sent to individual Surveillance and Broadcast Services (SBS) radio stations for uplink to aircraft.

[2] The () notation indicates the most current document revision.

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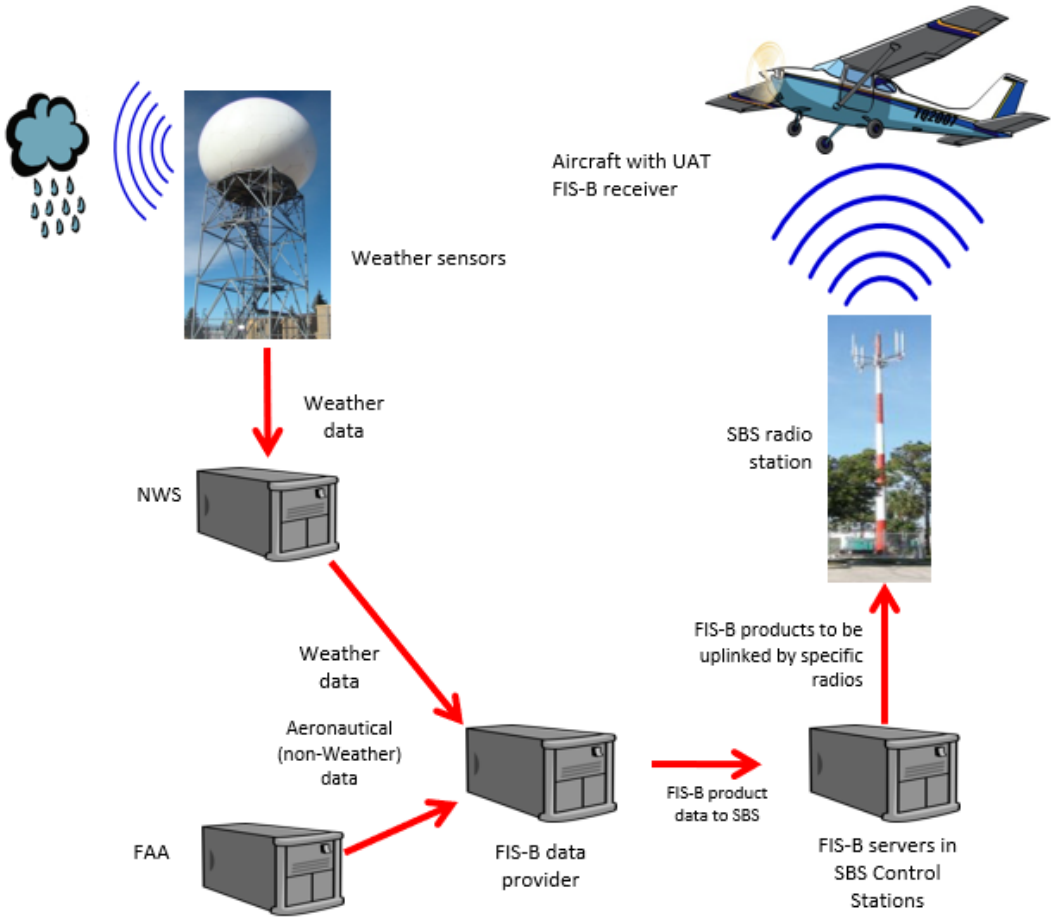


Figure 1-1: High-level Data Flows Supporting FIS-B

1.2.1 Document Hierarchy

Higher-level end-to-end system requirements are described in RTCA DO-267A, *Minimum Aviation System Performance Standard (MASPS) for Flight Information Services – Broadcast (FIS-B) Data Link*, dated April 29, 2004. RTCA DO-267A documented both MASPS and MOPS for FIS-B. DO-358() was created to replace the MOPS portion of RTCA DO-267A for FIS-B with UAT.

1.3 Operational Application(s)

The goal of the FIS-B system codified in this MOPS is to provide MET and aeronautical information to pilots in a manner that will enhance their awareness of the flight conditions and enable better strategic route planning consistent with guidance provided by Federal Aviation Regulations (FAR) and corporate policy. The information provided through FIS-B is considered non-binding advice provided to assist in the safe and legal conduct of flight

operations. With this information, flight crews will be better able to assess the need to consider alternative route and altitude selection.

The FIS-B system has been deployed as a better mechanism for transmitting weather data to the cockpit as compared to Very High Frequency (VHF) radio communication. FIS-B products can be continuously received and stored to be readily available as needed or when requested by the pilot.

This FIS-B system is not intended to replace existing voice networks, Flight Service Station services or usurp any joint duties or responsibilities required by aircraft operators. Loss or non-receipt of FIS-B service would have no regulatory impact.

FIS-B products are to be used only for strategic/planning purposes and not for crew alerting. This is due to the fact that FIS-B products may have significant latency between the observation of a weather phenomenon, the issuance of a forecast or the change in airspace status and the display of that information in the cockpit. In addition, because their update rates are relatively low, FIS-B products should not be used for tactical maneuvering of the aircraft and should not be the sole basis for immediate corrective action by the pilot. FIS-B products are intended to enable pilots to determine if action should be taken well before it is required and should be used in conjunction with other information sources to support in-flight decisions.

The general aviation (GA) community benefits from FIS-B by having better in-flight access to information on MET phenomena that may pose a danger to the flight. In addition, because many GA flights are single-pilot operations, FIS-B enables GA pilots to gain a more comprehensive MET picture than currently obtainable via voice radio, thereby enabling better in-flight strategic decision-making. Finally, with the creation of Temporary Flight Restrictions (TFRs) becoming more prevalent due to national security concerns, FIS-B offers another means to increase the GA pilot's awareness of the status of airspace.

1.4 Intended Function

FIS-B with UAT equipment is intended to receive, process, and make available for display those FIS-B products broadcast over UAT and identified in this MOPS. The requirements in this MOPS solely support the intended function of FIS-B with UAT equipment. Manufacturers may choose which FIS-B-UAT products to implement, per Section 2.1.9. This MOPS did not consider, and does not provide requirements associated with the intended use of the FIS-B-UAT products. Similarly, this MOPS does not apply to FIS-B equipment or FIS-B products communicated over data links other than UAT, which is envisioned by RTCA DO-267A, *Minimum Aviation System Performance Standards (MASPS) for Flight Information Services – Broadcast (FIS-B) Data-Link*.

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1.5 Operational Goals

The operational goal is to display the FIS-B products on the flight deck in order to enhance pilot awareness of meteorological conditions and airspace constraints along the route of flight.

1.6 Assumptions

This MOPS is written under the assumption that FIS-B avionics receives its data from a UAT. Reference RTCA DO-282B, *Minimum Operational Performance Standards for Universal Access Transceiver (UAT) Automatic Dependent Surveillance – Broadcast (ADS-B)*.

1.6.1 FIS-B Implementation

The requirements in the MOPS are based on the implementation of FIS-B provided by the FAA in the United States (U.S.) and its territories.

It should be noted that the requirements reflect the operational status of the FIS-B ground system at the time this MOPS was published. Evolution of the FIS-B service and/or the source of the data, such as changes from providers of data input to SBSS (e.g., National Weather Service (NWS)) may in fact affect these requirements and would need to be addressed.

1.6.2 Coordinated Universal Time and Date Access

It is assumed that the FIS-B avionics can access current Coordinated Universal Time (UTC) date and time.

1.7 Test Procedures

The test procedures specified in this document are intended to be used as one means of demonstrating compliance with the equipment performance requirements defined in Section 2.2. Although specific test procedures are cited, it is recognized that other methods may be preferred. These alternate procedures may be used if they provide at least equivalent information. In such cases, the procedures cited herein should be used as one criterion in evaluating the acceptability of the alternate procedures. Users of this document should not infer equipment performance requirements based on test procedures.

The order of tests specified suggests that the equipment be subjected to a succession of tests as it moves from design, and design qualification, into operational use. For example, compliance with the requirements of Section 2 shall have been demonstrated as a precondition to satisfactory completion of the installed system tests of Section 3.

a. Environmental Tests

   Environmental test requirements are specified in Section 2.3. The procedures and their associated limits are intended to provide a laboratory means of determining

the electrical and mechanical performance of the equipment under environmental conditions expected to be encountered in actual operations.

Unless otherwise specified, the environmental conditions and test procedures contained in RTCA DO-160G Change 1/EUROCAE ED-14G Change 1, *Environmental Conditions and Test Procedures for Airborne Equipment*, will be used to demonstrate equipment compliance.

b. Bench Tests

Bench test procedures are specified in Section 2.4. These tests provide a laboratory means of demonstrating compliance with the requirements of Section 2.2. Test results may be used by equipment manufacturers as design guidance, for monitoring manufacturing compliance and, in certain cases, for obtaining formal approval of equipment design.

c. Installed Equipment Considerations

Tests for the installed equipment are included when performance cannot be adequately determined through bench testing.

The installed equipment test procedures and their associated limits are specified in Section 3. Although bench and environmental test procedures are not included in the installed equipment test, their successful completion is a precondition to completion of the installed test. In certain instances, however, installed equipment tests may be used in lieu of bench test simulation of such factors as power supply characteristics, interference from or to other equipment installed on the aircraft, etc. Installed tests are normally performed under two conditions:

1. With the aircraft on the ground and using simulated or operational system inputs.
2. With the aircraft in flight using operational system inputs appropriate to the equipment under test.

Test results may be used to demonstrate functional performance in the intended operational environment.

1.8 Definition of Terms

The terms defined in this section are important terms used in this document.

Available for Display—In numerous requirements, the phrase "The FIS-B Avionics shall make available for display [data] ..." is used. In this context, this phrase means that the FIS-B Avionics stores the received information such that when the [data] is displayed to the flight crew, the most recent [data] received is displayed. In this context, received is understood to mean that the entirety of the uplink product, or self-standing piece thereof, was decoded by the FIS-B Avionics. An example of a self-standing piece thereof is one Global Block of Regional NEXRAD. A self-standing piece thereof would not include one segment of a product with APDU segmentation.

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Note:

1. *The Available for Display definition is not intended to prevent a manufacturer from displaying multiple time-sequential versions of the same [data] to convey trend information or changes over time in [data]. In instances where multiple time-sequential versions of the same [data] are displayed, any prior and the most current version need to be clearly identified as such.*
2. *When presenting title or legend, it should be simultaneously displayed with the [data].*

Decode—When used in this document, the term decode refers to the processing, parsing and translating of the data from its encoded uplink format.

FIS-B Avionics—The avionics components required for the cockpit display of those FIS-B products uplinked by the FIS-B ground system. The FIS-B avionics includes a processor and display and depending on the design, may also encompass the UAT receiver.

FIS-B Ground System—That portion of the FAA's ground network and equipment providing the uplink of FIS-B products within the U.S. and its territories.

FIS-B Latency—The use of the term latency associated with the requirements in this document represents the time interval between reception of a complete FIS-B message, to include reassembled segmented APDUs, by the FIS-B processor and display of the contents of that FIS-B message on the FIS-B display.

FIS-B Product File—When the FIS-B Report cannot be contained in a single UAT Ground Uplink Message, it is segmented into a Product File spanning multiple UAT Ground Uplink Messages.

Graphical Record—The component of the Text with Graphical Overlay (TWGO) product that contains the graphical information. Also referred to as graphic record.

Informative Appendix—An appendix, which may include details such as a committee list, definition of terms, etc., and does not convey or support any requirements of this MOPS.

Look-ahead Range—This relates to the minimum guaranteed radius for which a given product is provided from a given radio station.

May—The use of this term indicates an implementation characteristic that is permissible and completely left to the vendor's decision.

Normative Appendix—An appendix which may include details such as message encoding formats, antenna characteristics, filtering schemes, etc., and must be taken into consideration by the equipment designer in meeting the requirements of this MOPS.

Notice to Airmen (NOTAM) D - A classification of NOTAMs containing information concerning the establishment, condition, or change in any aeronautical facility, en route navigational aids, services procedures, hazards and civil public use airports.

Radio Station—The component of the FIS-B ground system broadcasting the FIS-B information.

Shall—The use of this term indicates a requirement.

Note: *The number contained in [ ] immediately after the term "shall" indicates the requirement number.*

Should—The use of this term indicates a characteristic that is highly recommended but is not required.

Significant Meteorological Information (SIGMET) Product—SIGMET and Convective SIGMET (WST) are advisories that contain meteorological information concerning the safety of aircraft. The two products have slightly different scope and criteria. Unless differentiated by the text, the MOPS use of the term SIGMET applies to both products.

Transmission Interval—The interval of time between consecutive broadcasts of a specified FIS-B product from a radio station. This interval depends upon the product type.

Note: See APPENDIX C for the update and transmission intervals by product type. For most products, the Transmission Interval is shorter than the Update Interval.

Update Interval—The interval of time between updates of the content of the FIS-B products within the FIS-B ground system. This interval depends upon the product type.

Uplink—The transmission of data from the FIS-B ground system.

1.9 Acronyms/Abbreviations

Table 1-1 lists the acronyms and abbreviations used throughout this MOPS document.

Table 1-1: Acronyms and Abbreviations

Acronym / Abbreviation	Explanation
3D	Three-Dimensional
AC	Advisory Circular
ADS-R	Automatic Dependent Surveillance – Rebroadcast
AGL	Above Ground Level
AIRMET	Airmen's Meteorological Information
APDU	Application Protocol Data Unit
ARTCC	Air Route Traffic Control Center
AWC	Aviation Weather Center
BN	Block Number

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