



Advisory Circular

U.S. Department
of Transportation
**Federal Aviation
Administration**

Subject: SAFETY AND INTEROPERABILITY
REQUIREMENTS FOR INITIAL DOMESTIC
FLIGHT INFORMATION SERVICE-BROADCAST

Date: 8/31/05

AC No: 20-149

Initiated by: AIR-130

Change:

1. PURPOSE.

a. This advisory circular (AC) supports the introduction and use of Flight Information Service-Broadcast (FIS-B) weather and other aeronautical data link products for enhanced situational awareness. It identifies safety and interoperability requirements for continued airworthiness of aircraft FIS-B equipment, systems, and applications. Like all advisory material, this AC offers one way, but it is not the only way, to comply with regulations.

b. We have written this AC for manufacturers and installers of FIS-B equipment and software, FIS providers, applicants for FAA design approval of FIS-B systems, and FAA aircraft certification office (ACO) staff who assess FIS-B systems. We've included a comment form in appendix 3 that you can use to give us feedback.

2. USING AC 20-140 WITH THIS AC. We expect you to use this AC with AC 20-140, *Guidelines for Design Approval of Aircraft Data Link Communications Equipment*. AC 20-140 describes a standardized way to identify the data communications equipment operational environment, execute an operational hazard assessment, and allocate resulting safety and interoperability requirements for installing FIS-B equipment. Appendix 1 lists sections from Title 14 of the Code of Federal Regulations (14 CFR) parts 23, 25, 27, and 29 that you should consider when determining the certification basis for approving aircraft data communications systems and applications.

3. WHAT THIS AC WILL COVER. Portable display systems that do not require design approval are outside the scope of this AC (see AC 120-76, *Guidelines for the Certification, Airworthiness, and Operational Approval of Electronic Flight Bag Computing Devices*). We do, however, cover the following:

a. Weather and Aeronautical Information Sources. FIS weather and aeronautical information is gathered by several sources using direct observation and instrumented sensors. Approved aviation weather information-gathering sources include:

The National Weather Service (NWS),

- Sources approved by the NWS,
- Sources authorized by FAA orders.
- NEXRAD products from national NEXRAD Information Distribution System (NIDS) vendors.
- NOTAMs and NAS status information.

b. FIS Providers. FIS providers are responsible for gathering weather and NAS status information from sources appropriate for the services they intend to provide. FIS providers then process this information into a format suitable for data link. This formatted information is then encoded for distribution to their communication subnetwork. The guidance in this AC applies to any of the following:

- FIS services provided by the FAA.
- FIS providers operating under contract with the FAA using aeronautical spectrum.
- Non-FAA FIS providers operating under customer contract using aeronautical spectrum.
- Non-FAA FIS providers operating under customer contract using other than aeronautical spectrum.

c. Communication Subnetworks. This AC allows the FIS-B system to use a variety of air-, ground-, and space-based communication subnetworks.

d. Aircraft Environment. The aircraft FIS-B system communicates with ground end-systems managed by a service provider. Depending on the FIS service in question, the aircraft's FIS-B equipment will monitor the appropriate subnetwork for broadcast FIS services. The aircraft's FIS-B systems are responsible for the control, display and alerting of FIS products in the cockpit. Aircraft systems with this capability are hereafter referred to as FIS-B systems.

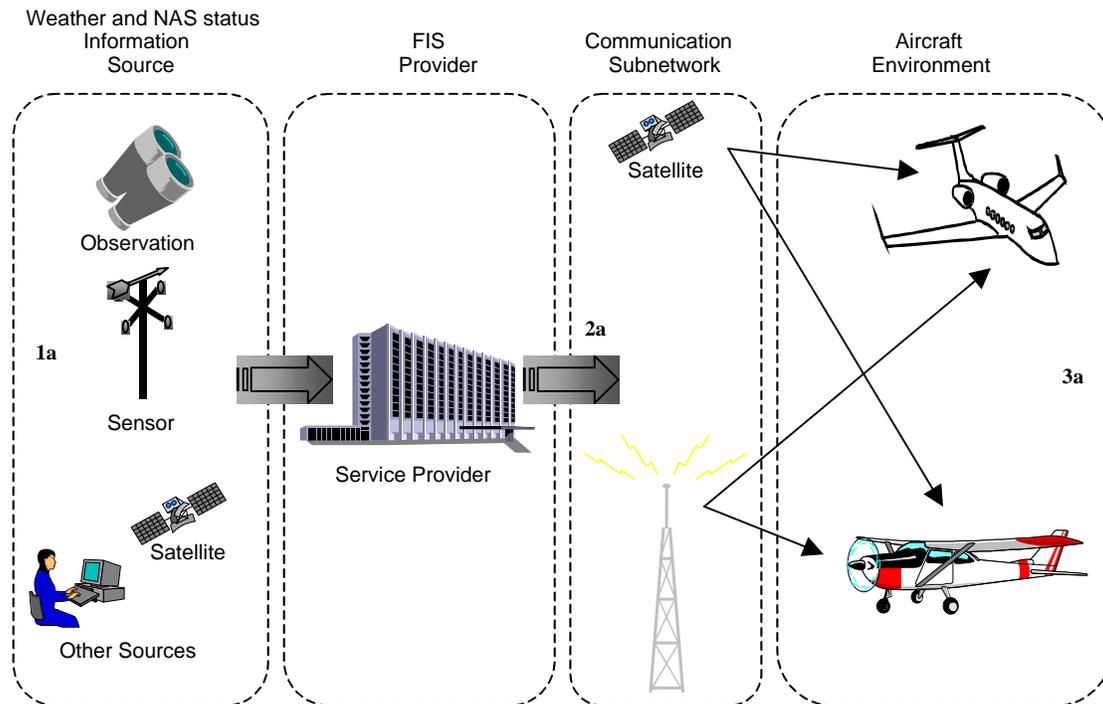
e. Relationship to AC 20-140. This AC supplements AC 20-140 by describing FIS services, establishing safety assessment considerations for FIS-B equipment installation, and identifying the allocated safety and interoperability requirements (see paragraph 6). Implementation of request-reply FIS service and FIS services obtained from onboard Internet access systems are specifically not covered here. Applicants proposing request-reply FIS equipment installation will have to assess the safety and interoperability requirements as part of an airworthiness review under AC 20-140.

f. Safety Assessment Considerations. This AC describes the operational context as part of the safety assessment considerations. We will justify hardware and software design assurance

minimums and specify safety requirements. For the FIS-B services and products specified in this AC, FIS-B information is limited to strategic operations only.

4. OVERVIEW OF THE FIS-B SYSTEM.

Figure 1: *Overview of the FIS-B System.*



General FIS Information Flow Description. Figure 1 represents a one-way, non-addressed, broadcast FIS service that uses either ground- or space-based data link systems. It represents the scope and applicability of this AC. Broadcast FIS data flows only from the service provider to the receiving aircraft. The aircraft doesn't need to ask for the information, nor acknowledge it. Additionally, information from the service provider is not addressed to any specific aircraft. It's intended for the benefit of all suitably equipped aircraft within the coverage volume. As this example shows, the FIS service provider assimilates weather and other information gathered from observations, weather sensors, instruments, and other data sources (1a). Once formatted and processed, the service provider encodes and distributes that information to the broadcast communication subnetwork of choice (2a), where the FIS-B service is sent to the aircraft and displayed in cockpits of properly equipped aircraft (3a).

5. SAFETY ASSESSMENT CONSIDERATIONS. Appendix 2 is the functional hazard assessment used to establish FIS-B safety requirements. We expect that technical advances and future use of FIS-B may change the operational environment--for example, FIS-B products may be adopted as a real-time tactical tool for navigation through severe weather. Such changes will affect the safety assessment considerations and resultant hardware/software design assurance minimums in this AC. If you are applying for design approval, verify that the FIS-B operational

assumptions in appendix 2 are correct. If the assumptions reflect the operational environment (that is, FIS-B is used for flight planning purposes only), then conduct a system safety assessment to verify that the likelihood of encountering FIS-B equipment failure conditions is no greater than 'probable.' If the FIS-B operational hazard assessment assumptions in appendix 2 are not correct, then conduct an operational hazard assessment defined in AC 20-140 to determine the FIS-B airborne functional hazard classification. AC 20-140 offers guidelines for conducting FIS-B safety assessments for design approval.

a. Operational Context. FIS-B systems are not meant to replace voice radio services. Voice communication of weather and other information, under the operating rules, is required. Loss or non-receipt of FIS-B products is not essential for flight operations. Operators use FIS-B products to supplement or complement existing sources of weather and operational information only. These existing sources are, for example, Flight Service Station voice networks, Air Traffic Control (ATC) facilities, the corporate/airline dispatcher networks, or all three. The safety assessment is based on the following assumptions:

(1) Loss of FIS -B Function. Loss of FIS-B is a minor failure condition. FIS-B supplements existing requirements for voice communication capability and does not replace ATC, Flight Service Station (FSS), and, if applicable, Airline Operations Control Center (AOCC) voice communications for aeronautical weather, special use airspace, NOTAM, or other operational information sent to aircraft in-flight.

(2) Effects of Undetected Errors. The effects of undetected errors -- messages received out of sequence, errors in message address, weather severity, displayed errors in weather and NOTAM location (offset) errors, and errors in the data compression technique-- in FIS-B products are a minor failure condition. FIS-B is limited to the operational context of paragraph 5(a), above. These failures are directly mitigated by operational and procedural constraints in the safety requirements (Airplane/Rotorcraft Flight Manual (A/RFM) Section 3 in paragraph 6(a)(3), below.

(3) Human/Machine Interface. The loss, corruption (or both) of FIS-B information intended for display to the pilot or flight crew during normal flight operations introduces a marginal increase in pilot workload. At a minimum, we determined that this increase in pilot workload contributes to a minor failure condition classification.

b. Aircraft Integration Aspects. Consult AC 20-140, paragraph 7(e), to determine the impact to the safety assessment on integrating the FIS-B system into the aircraft's existing avionics suite. Integration of FIS-B functionality should not compromise shared aircraft resource performance.

c. Post Certification Design Changes to Airborne FIS-B Equipment. We expect that FIS provider textual and graphical product additions, enhancements, or both may promote aircraft FIS-B equipment changes. Such changes will most likely affect FIS-B equipment software. We strongly encourage airborne equipment manufacturers to review AC 20-140, paragraph 6(e)(5)(f) to ensure that changes cause no deleterious effects to system safety. Further, we encourage applicants to consult their local geographic ACO for guidance on approval of airborne systems and equipment with user-modifiable software. Applicants intending to install aircraft FIS

systems based upon field approval substantiated by an STC on another make / model aircraft, should consult the local flight service district office for current policy guidance before installation.

6. ALLOCATED SAFETY AND INTEROPERABILITY REQUIREMENTS. Applicants should identify the allocated safety and interoperability requirements in AC 20-140, paragraph 6(e)(3). If you are an applicant and decide to use this AC to satisfy the objectives of AC 20-140, then the following safety and interoperability requirements apply:

a. Aircraft Requirements.

(1) At a minimum, develop FIS-B systems and equipment to a hardware and software design assurance level commensurate with a minor failure condition.

(2) The following A/RFM or A/RFM supplement wording applies to FIS-B installations covered by this AC.

(a) Operating Limitations. No wording proposed.

(b) Operating Procedures. The A/RFM, Section 3, Normal Operating Procedures, should state the following:

Use FIS-B information as a strategic planning tool for pilot decisions on avoiding inclement weather areas beyond visual range or where poor visibility precludes visual acquisition of inclement weather. Use FIS-B weather and NAS status information as follows:

a. To aid pilot situational awareness of hazardous meteorological conditions and awareness of the regulatory status of the airspace.

b. To cue the pilot to communicate with the ATC controller, AFSS specialist, operator dispatch, or AOCC for more information about the current meteorological conditions or regulatory airspace status.

In no case should the pilot take any evasive action based solely on the information on a FIS-B display. FIS-B information is meant to aid strategic flight planning only. It lacks sufficient resolution and updating necessary for tactical maneuvering.

The FAA has approved the FIS-B system and applications to the criteria in AC 20-140, dated August 16, 1999. This approval was based on the safety and interoperability requirements in AC 20-149, dated September 30, 2004. This design approval is not an operational authorization.

(3) Aircraft FIS-B equipment should meet the interoperability requirements in RTCA/DO-267A, *Minimum Aviation System Performance Standards for Flight Information Services-Broadcast (FIS-B) Data Link, Sections 2.0 and 3.0*, dated April 4, 2004. Compliance

with RTCA/DO-267A, Section 2.2.11.2.1, *Weather Product Discard*, does not apply to airborne FIS-B equipment requirements.

b. FIS Provider Requirements. FIS providers should meet the interoperability requirements in RTCA/DO-267A, Sections 3.0 and 4.0.

7. GROUND AND FLIGHT TEST EVALUATION.

a. FIS-B products available for display to the cockpit will likely undergo product improvement changes while the aircraft operator subscribes to various FIS providers for products best suiting their individual operational needs. This AC takes into account the means of mitigating hazards associated with post-design approval changes to FIS-B product content. Such post-design approval changes would be a direct result of the aircraft operator changing FIS providers, or the FIS provider offering FIS-B product enhancements.

b. Flight test guidelines for FIS-B equipment are in AC 20-140, Section 10. We expect applicants to demonstrate the guidelines of AC 20-140, Section 10, during the initial type certification effort for installation of FIS-B systems and equipment. If there are FIS-B system constraints per paragraph 5(c) above, we won't require a re-demonstration of AC 20-140, Section 10 for post certification minor changes to the aircraft user-modifiable FIS-B message content (that is, FIS provider unique uplinks).

c. RTCA/DO-267A, Section 3.8 and Table 3-2, outlines appropriate color use for FIS-B equipment. The colors red, amber/yellow, and green have special significance, due to their stereotypical use to convey status, urgency, or criticality of conditions. The following conventions are acceptable in all aircraft installations. First, a progression from green to amber to red representing increasing degrees of threat, potential hazard, safety criticality, or need for flight crew awareness or response. Red and amber/yellow are typically reserved for conditions with safety consequences, such as system failures, severe weather, envelope limits, etc. Red is used to identify significant safety threats, either immediate (a fire warning) or potential (severe weather, even if not on the projected flight path). Amber/yellow is used to identify less significant threats. Green is used to indicate normal conditions or other conditions that do not represent significant threats.

d. To ensure compatibility with existing displays and to ensure that they maintain effectiveness across a wide variety of functions and applications, apply the following principles when determining what, if any, features of FIS-B displays should be coded red, amber and green. Use the following Part 25 guidance instead of the color guidance in RTCA/DO-267A, section 3.8 and Table 3-2:

(1) Color assignments should follow the "strategic display philosophy of increasing potential safety hazard" so that the progression from green to amber (yellow) to red corresponds to increasing degrees of threat, hazard, safety criticality, or need for flight crew awareness or response.

(2) The uses of red, yellow/amber, and green must be compatible, although not necessarily identical, across the various displays and indications, to ensure that they maintain their effectiveness and intended functions.

(3) If used, red should be associated with a need for immediate flight crew awareness and/or conditions that represent serious near-term or serious potential threats to safety.

(4) If used, amber should be associated with a need for flight crew awareness and/or conditions that represent moderate near-term or moderate potential threats to safety.

(5) If used, green should be associated with normal, safe operation.

(6) At no time should a display surface simultaneously present color-coded information that requires immediate awareness and possible action in combination with like color-coded information that is advisory in nature.

e. The flight crew should be able to quickly, accurately and consistently differentiate between time-critical information and dated, non-time-critical information.

8. BACKGROUND.

a. The FAA's goal for FIS in the cockpit is to use digital data link to deliver information to the pilot, and in doing so, improve safety, reduce costs to users and the FAA, and increase the utility, efficiency, and capacity of the national airspace system (NAS). Timely delivery of high quality, accurate, and consistent information is essential for sound operational decisions by pilots, controllers, and dispatchers.

b. For many years, the Aircraft Communication Addressing and Reporting System (ACARS) have given aircraft operators a means of digitally up-linking weather and NAS status information for display in text format. More recently, short-term weather uplink programs sponsored by the FAA were made available to ACARS equipped aircraft, at selected airports. Text messages and basic alphanumeric character graphics could be generated based on data from either Terminal Doppler Weather Radar (TDWR) or the Integrated Terminal Weather System (ITWS) test bed. These weather products include terminal weather conditions with descriptions/depictions of the present and expected convective activity, including gust fronts and microbursts within 15 nautical miles of the terminal area. This gave pilots strategic information to help with their in-flight planning before arriving or departing the terminal area.

c. On May 1, 1998, the FAA published the Airborne Flight Information Services (FIS) Policy Statement, high-level guidance for the implementation of FIS services. To speed early implementation of FIS services, the FAA in July 1999 signed a five year Government-Industry Project Performance Agreement (G-IPPA) with a third party, non-federal FIS Data Link (FISDL) provider to disseminate basic weather and NAS status information as a VHF data communication service. Format and coding of these information products is described in AC-00-45E, *Aviation Weather Services*, dated December 1999, and the Aeronautical Information Manual (AIM), Paragraph 7-1-27.

d. This third-party VHF FISDL provider sends a basic set of free weather products to appropriately equipped aircraft, and uplinks value added services on a paid subscription basis. The basic set of products includes:

Aviation Routine Weather Reports (METARs).

- Aviation Selected Special Weather Reports (SPECIs).
- Terminal Area Forecasts (TAFs), and their amendments.
- Significant Meteorological Information (SIGMETs).
- Convective SIGMETs.
- Airman's Meteorological Information (AIRMETs).
- Pilot Reports (both urgent and routine) (PIREPs).
- Alert Severe Weather Watch bulletins (AWWs), as issued by the NWS.

e. VHF FISDL value added services are provider-unique products for subscribers who pay for them. Value added services offer more data content and format than the basic requirements listed above. They include:

- Precipitation maps based on NEXRAD mosaics,
- Graphical presentations of in-flight icing conditions, turbulence depictions,
- NOTAMs, and
- Special Use Airspace (SUA) depictions.

9. RELATED INFORMATION. We consider the following documents essential for determining the means for showing that the FIS-B data communications system complies with the certification basis.

- RTCA/DO-267A, *Minimum Aviation System Performance Standard (MASPS) for Flight Information Services-Broadcast (FIS-B) Data Link*, dated April 4, 2004.
- AC 20-140, *Guidelines for Design Approval of Aircraft Data Link Communications Equipment*, dated August 16, 1999.
- AC 23.1311-1, *Installation of Electronic Display Instrument Systems in Part 23 Airplanes*, dated June 11, 1993.
- AC 25-11, *Transport Category Airplane Electronic Display Systems*, dated July 16, 1987.
- AC 120-76A, *Guidelines for the Certification, Airworthiness, and Operational Approval of Electronic Flight Bag Computing Devices*, dated March 17, 2003.

- AC 00-62, *Internet Communications Of Aviation Weather And NOTAMS*, dated November 1, 2002.
- Doc 4444, ATM/501, International Civil Aviation Organization (ICAO), *Procedures for Air Navigation Services / Air Traffic Management*, 14th Edition, dated November 1, 2001.

David W. Hempe
Manager, Aircraft Engineering Division
Aircraft Certification Service

APPENDIX 1. DEFINITIONS AND ACRONYMS

1. Definitions.

Airline Operations Control Center (AOCC). An air carrier dispatch service, or other operator's aeronautical weather and operational information service.

Basic Product: A product offered by the FAA FISDL provider at no cost to the contract holder.

Broadcast Data Link: Data link transmission with no requirement for an initiating request from the receiving station. Further, the broadcast data link transmission, as defined in RTCA/DO-267A, does not contain message recipient address information.

Broadcast message: Message using a broadcast protocol that does not depend on a request from the receiver. This AC refers specifically to the broadcast protocol in RTCA/DO-267A.

Flight Information Services (FIS). The ICAO defines FIS in the 14th Edition of Doc 4444, *ATM/501, Procedures for Air Navigation Services / Air Traffic Management*, November 1, 2001, as a service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flight. Further, ICAO has defined specific request-reply data link services in the Aeronautical Telecommunications Network (ATN) Standards and Recommended Practices (SARPs) document 9705. The term "FIS" in this AC, however, includes a much broader scope of services, applications, and formats: FIS includes near real-time advisories and warnings that may affect flight safety and flight information planning services used in strategic flight planning. Additionally, FIS is limited to broadcast data link services not requiring request-reply.

Flight Information Services-Broadcast (FIS-B). Means of disseminating FIS by broadcast (a non-directed transmission intended to be received by all stations).

Flight Information Services Data Link (FISDL). The provision of FIS data over various broadcast data links, including weather and operational information for display in the cockpits of appropriately equipped aircraft.

(FAA) FISDL Service Provider: Organization providing FAA FISDL on Aeronautical Spectrum under an agreement with the FAA.

(Non-FAA) FISDL Service Provider: Organization that operates a commercial data link system providing aviation weather and operational information without an agreement with the FAA.

Flight Information Service Provider (Non-FAA): Commercial data link service providing aviation weather and operational information to customers.

APPENDIX 1. DEFINITIONS AND ACRONYMS (CONTINUED)

Graphical product: FIS product composed of graphics with associated supporting text.

NEXRAD: NEXRAD (Next Generation Weather RADAR) is a Doppler weather radar system developed and deployed as a tri-agency program by the Department of Transportation (FAA), the Department of Commerce (NWS), and the Department of Defense. NEXRAD provides surface weather radar coverage and is an essential input to various aviation weather products. NEXRAD radar systems are designated WSR-88D (Weather Surveillance RADAR-88 Doppler).

Text product: FIS product composed of text only.

Value-Added Product: Product offered by an FAA FISDL provider for a fee.

APPENDIX 1. DEFINITIONS AND ACRONYMS (CONTINUED)

Acronym	Description
AC	Advisory Circular
ACARS	Aircraft Communication, Addressing and Reporting System
ACO	Aircraft Certification Office
AIM	Aeronautical Information Manual
AIRMET	Airman's Meteorological Information
AOCC	Airlines Operation Control Center
AFSS	Aircraft Flight Service Station
A/RFM	Airplane/Rotorcraft Flight Manual
ATC	Air Traffic Control
ATN	Aeronautical Telecommunication Network
AWW	Alert Severe Weather Watch
FAA	Federal Aviation Administration
FIS	Flight Information Service
FIS-B	Flight Information Services – Broadcast
FISDL	Flight Information Service Data Link
FSS	Flight Service Station
G-IPPA	Government – Industry Project Performance Agreement
ICAO	International Civil Aviation Organization
ITWS	Integrated Terminal Weather System
METARs	Aviation Routine Weather Reports
MOPS	Minimum Operational Performance Standard
NAS	National Airspace System
NEXRAD	Next Generation Radar
NIDS	NEXRAD Information Distribution System
NOTAM	Notice to Airmen
NWS	National Weather Service
PIREPs	Pilot Reports
SARPS	Standards and Recommended Practices
SIGMET	Significant Meteorological Information
SPECIs	Special Aviation Reports

APPENDIX 1. DEFINITIONS AND ACRONYMS (CONTINUED)

Acronym	Description
TAFs	Terminal Area Forecasts
TDWR	Terminal Doppler Weather Radar
TSO	Technical Standard Order
VHF	Very High Frequency

**APPENDIX 2. OPERATIONAL HAZARD ASSESSMENT
OF FIS-B PRODUCTS**

Failure Description	Failure Condition	Hazard Classification	Remarks and Assumptions
Function Loss of FIS-B data, all flight phases	No information displayed to flight crew	Minor	<p>FIS-B data not required for normal operations.</p> <p>Loss readily apparent to flight crew.</p> <p>Marginal increase in pilot workload.</p> <p>Flight crew uses VHF voice as backup.</p>
Malfunction of FIS-B equipment, all flight phases	Misleading information displayed to flight crew	Minor	<p>FIS data not required for normal operations.</p> <p>Flight crew should not initiate evasive maneuvers based solely on FIS-B data communications equipment.</p> <p>Marginal increase in pilot workload.</p> <p>Flight crew uses VHF voice as backup.</p>

APPENDIX 3. FORM TO SUBMIT SUGGESTIONS FOR IMPROVEMENT

Use this form, or create your own to submit comments for improving future releases of advisory material on design approval of data communications systems and applications.

Suggestion for Improvement	
Send To: FAA, Aircraft Certification Service Aircraft Engineering Division (AIR-130) 800 Independence Avenue Washington, D.C.	Date:
Name:	
Voice:	Address
Fax:	
Internet:	
Reference sections:	
Rationale (Describe the reason for the change)	
Proposed change (Attach marked-up text or proposed rewrite)	
Please provide general comments to improve this AC	