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Integrated Modular Avionics (IMA) Development Guidance and Certification Considerations

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Foreword

This document was prepared jointly by RTCA Special Committee (SC-200) and EUROCAE Working Group 60 and approved by the RTCA Program Management Committee (PMC) on November 8, 2005.

RTCA, Incorporated is a not-for-profit corporation formed to advance the art and science of aviation and aviation electronic systems for the benefit of the public. The organization functions as a Federal Advisory Committee and develops consensus based recommendations on contemporary aviation issues. RTCA's objectives include but are not limited to:

- Coalescing aviation system user and provider technical requirements in a manner that helps government and industry meet their mutual objectives and responsibilities;
- Analyzing and recommending solutions to the system technical issues that aviation faces as it continues to pursue increased safety, system capacity and efficiency;
- Developing consensus on the application of pertinent technology to fulfill user and provider requirements, including development of minimum operational performance standards for electronic systems and equipment that support aviation; and
- Assisting in developing the appropriate technical material upon which positions for the International Civil Aviation Organization and the International Telecommunications Union and other appropriate international organizations can be based.

The organization's recommendations are often used as the basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration technical Standard Orders.

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EXECUTIVE SUMMARY

The use of Integrated Modular Avionics (IMA) is rapidly expanding and is found in all classes of aircraft. In recognition of this rapid growth RTCA established Special Committee 200 (SC-200) and EUROCAE established Working Group 60 (WG-60) to jointly develop a document that could be used as guidance in the design, development, and application of IMA. Participants in the development of the document included government, industry, and academic personnel.

IMA is a shared set of flexible, reusable, and interoperable hardware and software resources that, when integrated, form a platform that provides services, designed and verified to a defined set of safety and performance requirements, to host applications performing aircraft functions.

This document provides guidance for IMA developers, integrators, applicants, and those involved in the approval and continued airworthiness of IMA systems. It provides specific guidance for the assurance of IMA systems as differentiated from traditional federated avionics.

The development of this document is based on earlier RTCA/EUROCAE documents, for example RTCA DO-178/EUROCAE ED-12, Software Considerations in Airborne Systems and Equipment Certification and RTCA DO-254/EUROCAE ED-80, Design Assurance Guidance for Airborne Electronic Hardware. Concepts from other RTCA and EUROCAE documents, as well as SAE and ARINC documents, also guided the document preparation.

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CHAPTER 1 INTRODUCTION

1.1 PURPOSE

This document contains guidance for Integrated Modular Avionics (IMA) developers, application developers, integrators, certification applicants, and those involved in the approval and continued airworthiness of IMA systems in civil certification projects. The guidance describes the objectives, processes, and activities for those involved in the development and integration of IMA modules, applications, and systems to incrementally accumulate design assurance toward the installation and approval of an IMA system on an approved aviation product as differentiated from traditional federated aviation system architectures.

IMA system concepts are presented, including the platform and modules, and their relationships to the hosted applications and avionics functions used in an aircraft installation. This includes the description of how the developers and integrators can accumulate incremental acceptance of the modules, platform, and application integration which will provide a means for applicants to achieve design assurance of an IMA system on an approved aviation product.

During the IMA system development the certification applicant for a Type Certificate (TC) or Supplemental Type Certificate (STC) program should develop an effective system of communication among the module and platform developers and system integrators. This is especially important when these suppliers are from different companies. Otherwise, there may be a misunderstanding of the implementation during final integration and approval of the IMA system installation.

Six tasks define the incremental acceptance of IMA systems in the certification process:

- Task 1: Module acceptance.
- Task 2: Application software or hardware acceptance.
- Task 3: IMA system acceptance.
- Task 4: Aircraft integration of IMA system - including Validation and Verification (V&V).
- Task 5: Change of modules or applications.
- Task 6: Reuse of modules or applications.

Approval of an IMA system installation may be based on the accumulation of incremental acceptance, culminating in the complete design assurance needed to demonstrate that the installed system and functions comply with the applicable regulations and guidance.

The incremental acceptance, if appropriate, may be granted in the form of an acceptance letter, stamped type design data, or other means for the specific project.

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1.2 SCOPE

This document is applicable to all parties involved in the development, integration, verification, and validation of IMA systems. The guidance in this document is focused on IMA-specific aspects of design assurance. As such it relies on other recognized documents that provide additional guidance on overall aircraft certification, system development, software assurance, and hardware assurance.

As defined in this document, IMA is described as a shared set of flexible, reusable, and interoperable hardware and software resources that, when integrated, form a platform that provides services, designed and verified to a defined set of requirements, to host applications performing aircraft functions. Key IMA and certification terms are described in Section 2.2 and in the glossary.

The primary industry-accepted guidance for satisfying airworthiness requirements for IMA components is included in Section 1.5. The ability to obtain incremental acceptance of individual items of the IMA platform (including the core software) and hosted applications enables the reduction of follow-on certification efforts without compromising system safety.

This document describes application properties as they relate to their integration with a platform; however, it does not address the specific functionality of applications nor specific Technical Standard Order (TSO)/European Technical Standard Order (ETSO) requirements, Minimum Operational Performance Specifications (MOPS), or Minimum Aviation System Performance Specifications (MASPS).

1.3 BACKGROUND

The evolution of software and microelectronics technology enables the introduction of new aircraft functions, new capabilities, and increased levels of complexity. The need to perform these complex functions necessitates the use of high-performance computing platforms that can host multiple applications on a single processor or a distributed network of processors.

Aircraft functions are increasingly being implemented by electronic systems. IMA is a means to accommodate this increase and reduce the number of units per aircraft. Additional benefits are reduced weight and volume of aircraft systems and equipment.

The IMA platform should be capable of providing robust partitioning and other protection means that allow multiple applications to share a platform and its resources, or to support functions distributed across a fault-tolerant network. An IMA platform may be provided by the system integrator or by a third party supplier. Likewise, IMA applications may be provided by the platform supplier or third party suppliers.

Economic factors, including the needs to provide cost-effective upgrade paths, introduce new operational capabilities (e.g., CNS/ATM functions), fast and efficient maintenance, and to avoid premature obsolescence are the primary incentives for the IMA concept. In light of this background, this document describes a set of processes and guidance to be used for the development and certification of IMA systems.

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1.4 RELATIONSHIP TO OTHER DOCUMENTS

In addition to the airworthiness regulations and requirements, various national and international standards for software, avionics, complex electronics, and safety are available. In some communities, compliance with these standards may be required. However, it is outside the scope of this document to invoke specific national or international standards, or to propose a means by which these standards might be used as an alternative or supplement to this document.

Where this document uses the term "standards" it should be interpreted to mean the use of project-specific standards as applied to the aircraft systems, equipment, and engines. Such standards may be derived from general standards produced or adopted by the applicant for their certification activities.

1.5 REFERENCES

The latest version of the following documents apply:

[1] RTCA DO-160 / EUROCAE ED-14, Environmental Conditions and Test Procedures for Airborne Equipment.
[2] RTCA DO-178 / EUROCAE ED-12, Software Considerations in Airborne Systems and Equipment Certification.
[3] RTCA DO-200 / EUROCAE ED-76, Standards for Processing Aeronautical Data.
[4] RTCA DO-201 / EUROCAE ED-77, Industry Requirements for Aeronautical Information.
[5] RTCA DO-248 / EUROCAE ED-94, Final Report for Clarification of DO-178B "Software Considerations in Airborne Systems and Equipment Certification".
[6] RTCA DO-254 / EUROCAE ED-80, Design Assurance Guidance for Airborne Electronic Hardware.
[7] SAE ARP4754 / EUROCAE ED-79, Certification Considerations for Highly Integrated or Complex Aircraft Systems.
[8] SAE ARP4761, Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment.
[9] Federal Aviation Administration (FAA) AC 20-148, Reusable Software Components.
[10] FAA TSO-C153, Integrated Modular Avionics Hardware Elements.
[11] FAA Order 8110.49, Software Approval Guidelines.
[12] ARINC 615A, Software Data Loading.
[13] ARINC 653, Avionics Application Software Standard Interface.
[14] ARINC 664, Aircraft Data Network.

NOTE: When FAA Advisory Circulars are referenced, they are intended as material that may supply topics and areas for the applicant to consider. All requirements should be coordinated with the applicant's local certification authority.

1.6 HOW TO USE THIS DOCUMENT

This document is intended to be used by the international aviation community. To aid in such use, references to specific national regulations and procedures are minimized.

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