

Modeling RTCA DO-178C Specification to Facilitate Avionic Software System Design, Verification, and Validation

Emanuel S. Grant and Tanaya Datta

Abstract—Avionic systems are safety-critical systems because system failure can be catastrophic resulting in loss of life and/or resources. Consequently, safety-critical systems must be developed carefully and adhere to standards such as DO-178C. As these types of systems need to maintain critical mechanisms, some of the mechanisms can be complicated and difficult to use appropriately, written descriptions can be vague and error prone. This paper aims to explore graphical specification method as alternative to represent the textual DO-178C. Several UML diagrams are created in order to represent DO-178C in a format that is easier related to model-driven software development. Specifically, UML Package Diagrams, Activity Diagrams and Class Diagrams are used to illustrate the various processes, sub-processes, activities and contents as defined in the DO-178C specification.

Index Terms—DO-178C specification, model transformation, safety-critical systems, UML diagrams.

I. INTRODUCTION

The impacts of safety in avionic systems that comprise software and hardware integration have to be considered at system development level. For this reason, such systems should be planned and developed in accordance with airborne software considerations and system standards. DO-178C is the "Software Considerations in Airborne Systems and Equipment Certification" [1]. DO-178C is the modified edition of DO-178B that was published in December 2011. DO-178C has the purpose similar as its predecessor, which is "providing guidance for the production of software for airborne systems and equipment that performs its intended function with a level of confidence in safety that complies with airworthiness requirements" [2]. There are changes in DO-178C which tighten some previously established controls and also established concrete guidance for more flexibility in development approaches. These flexibility includes examination of costs and benefits, establishment of certifiable product development approach [3].

The RTCA DO-178C specification "Software Considerations in Airborne Systems and Equipment

Certification" is an internationally accepted document that sets out guidelines to plan, design, development, and certify, software systems for the avionic industry. In a research project to develop a model-driven object-oriented software development methodology, for avionic systems it was determined that the textual format of DO-178C was a hindrance to the research effort. Consequently, work was directed at developing an alternative representation of DO-178C that would complement and enhance the research on developing the aforementioned methodology. The approach taken is to transform the textual representation of DO-178C into a set of UML (Unified Modeling Language) [4] models that would be in the same representation models of the research methodologies. The transformed representation of DO-178C would be in the form of UML package, class diagram, and activity diagrams. This would allow for a seamless transition from the DO-178C specification to the model-driven object-oriented software development methodology. The goal of this research is to develop a subset of the UML model representation of DO-178C as a precursor to defining the research methodology.

This paper is a description of a particular section of "RTCA DO-178C Software Considerations in Airborne Systems and Equipment Certification guidelines" titled Software Configuration Management Process [1]. This is one of the integral processes mentioned in this guideline in Section 7.0. This research transforms the textual description of this section into UML notation in the form of package diagrams, class diagrams and activity diagrams.

The structure of the remainder of the paper is as follows. Section II presents a background of the research project.

II. BACKGROUND

A. Software System Modeling

Modeling is a problem solving technique that is popular in many engineering disciplines [4], [5]. A model is defined as a representation of a system from a specific perspective that is intended to promote understanding of the real system and to provide the capability to serve as a high fidelity validation test beds prior to construction of the potential system [6]. The advantages of the modeling method include understanding complexity, evolution, and manipulation of the modeled systems, and simulations. Thus, models are used to better our understanding of fundamental processes. This can be useful in policymaking and interventions, concerning efficient training, scenario development, risk assessment, forensic analysis, and future trends prediction; resulting in simplifying the problem

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