
Contents

INTRODUCTION	ix
CHAPTER 1. DEVELOPING MODEL-BASED DESIGN METHODS IN SOFTWARE ENGINEERING	
1.1. The history of model-based design	1
1.2. The Unified Modeling Language, a support for model-based methods	3
1.2.1. The philosophy and history of the Unified Modeling Language	3
1.2.2. The Unified Modeling Language normalized diagrams	5
1.2.3. The advantages of model-based design	12
1.3. Formal model-based validation techniques	13
1.3.1. Model Checking	14
1.3.2. Formal theorem proving	18
1.3.3. Code assertion	19
1.3.4. Applying for certification for complex systems	20
CHAPTER 2. METHODOLOGY FOR RAPID PROTOTYPING AVIONIC SOFTWARE	
2.1. The specificities of the avionic domain	23
2.1.1. System virtualization: integrated modular avionics	24
2.1.2. MILS: divide and conquer, to rule over a secure world	27

2.1.3. Processing security and safety aspects simultaneously	30
2.2. The certification of an avionic system.	32
2.2.1. The qualification of tools for certification	32
2.2.2. Model-based development approaches in aeronautics	33
2.2.3. A sophisticated methodology for the development of complex onboard systems.	36
2.3. Methodology of rapid development in seven stages	36
2.3.1. Presentation of the different stages.	36
2.3.2. Advantages of the methodology	39
2.3.3. Example of the benefits of using our model-based methodology	45
2.3.4. Instantiation of the methodology with different tools.	46
2.4. Chapter summary.	59

**CHAPTER 3. IMPLEMENTING THE PROTOTYPING
METHODOLOGY TO DEVELOP A NEXT
GENERATION AVIONIC ROUTER** 61

3.1. Introduction to next generation aeronautical communication domains	61
3.1.1. Avionic and aeronautical network domains	61
3.1.2. Communication standards and protocols for next generation aeronautics	65
3.1.3. The benefits of a next generation avionic router: secure next generation router	67
3.2. Implementing the SNG router	71
3.2.1. Architecture of the SNG router software	71
3.2.2. Routing functionalities (IPv4)	74
3.2.3. Filtering functionalities (IPv4)	79
3.3. Evaluating the performance of the SNG router	85
3.3.1. Experimental framework	85
3.3.2. Metrics and tools for evaluating performance	88
3.3.3. Results of the performance measurements	96
3.4. Chapter summary.	106

Contents vii

CONCLUSION	109
BIBLIOGRAPHY	117
INDEX.	131