

# Situation Awareness with Systems of Systems



Piërre van de Laar • Jan Tretmans • Michael Borth  
Editors

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 Springer

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ISBN 978-1-4614-6229-3      ISBN 978-1-4614-6230-9 (eBook)  
DOI 10.1007/978-1-4614-6230-9  
Springer New York Heidelberg Dordrecht London

Library of Congress Control Number: 2012956306

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# Foreword

Nothing less than a disruption in thinking about naval systems was taking place at Thales when we, together with ESI, conceived the POSEIDON project. Thales has a long track record in defense systems – using many proprietary solutions designed to perform reliably under extreme operational conditions of armed conflict anywhere in the world. For the future, we wanted to enter the market of maritime safety and security (MSS). Systems supporting MSS missions impose very different requirements and in fact open up the possibility to utilize open source and state-of-the-art technologies from the civil domain.

Thales had a challenge in using commercial off-the-shelf technologies as they were traditionally not qualified to meet the demanding requirements of our core business of building highly reliable defense systems: How to conceive and develop a different type of system targeted at a new market opportunity? This had to be achieved with our existing pool of highly talented technical professionals with mission critical defense systems in their blood.

As with all high-tech organizations, it all begins with a handful of key people with a vision who are capable of convincing decision makers to allocate budgets to new projects that will result in attractive and smart solutions. This was all set in place with a number of projects running to achieve our MSS ambition. Expectations, however, were very high in the sense that it was assumed that we could reach the level of deliverable products very quickly; after all it was “R&D business as usual.” In our pragmatism, we missed the point somewhere in this palette of projects.

We were in need of a more out-of-the-box thinking that would come up with new concepts to pull the population at Thales across the line. This was where ESI, together with its partners, came in and POSEIDON was born. The Industry-as-Laboratory approach used by ESI was key in our decision to proceed. It matched our belief that product goals and research goals can go hand in hand. Given the right environment of quality staff, who understand, respect, and support each other’s goals and are backed up by facilities and processes, they catalyze each other and can achieve great results. This is exactly why POSEIDON has been so successful. It gave birth to numerous product concepts that found their way into our naval systems portfolio and also resulted in many publications and dissertations.

Now after 5 years, you will find everything you may want to know about the results of POSEIDON in this book. I would like to add, with reference to a famous Gestalt law, known from psychology, that “the whole is more than the sum of its parts.” Above all, POSEIDON has been a highly inspiring journey that substantially contributed to the mindset change now helping Thales to develop advanced naval systems for the future.



Delft, September 2012

Jimmy Troost  
Director TRT-Delft  
Thales Netherlands

# Preface

It is with great pleasure that I welcome you to the final book on the Embedded Systems Institute project POSEIDON. The project was funded under the Dutch BSIK program “Embedded Systems.” The project partners were the Embedded Systems Institute (ESI), Thales Netherlands, Noldus Information Technology, Delft University of Technology, Eindhoven University of Technology, University of Amsterdam, Tilburg University, and VU University Amsterdam. The project started in June 2007, ended in May 2012, and encompassed an overall volume of 84 fte.

As for all of ESI’s large projects, POSEIDON has followed the by now well-known Industry-as-Laboratory paradigm, in which scientific research is performed in the context of an industrial case. For POSEIDON, the case was defined in the context of the new emerging market of support systems for maritime safety and security. The POSEIDON partners addressed a variety of research topics ranging from integration and testing to systems-of-systems, from visualization to security, from vessel trajectory segmentation to adapter generation, and from situation awareness to trustworthy information interoperability.

The POSEIDON project has been highly successful. Among the results we count the following highlights:

- An architectural framework for information-centric systems of systems and an integrated demonstrator, showing how the combination of many new technologies can be applied to offer improved system support to coast guard operators for a higher level of situation awareness.
- An extendable method to analyze and visualize the kinematic behavior of moving objects. This method offers powerful solutions for the construction of user-defined operational pictures in next-generation maritime systems.
- A highly efficient data reduction method resulting in vessel trajectories using only 2 % of the original amount of data.
- A formal definition of a semantic concept hierarchy of maritime information, enabling automatic reasoning on semantic level with maritime concepts, implemented in a knowledge base.

- A new method for trust management and distributed access control for use in a systems-of-systems environment in the absence of a central security authority.
- Concepts and techniques for systems integration and acceptance at runtime: systems join-and-leave, runtime acceptance testing, and system health diagnosis.
- Adaptor generation techniques for the quick realization of reliable connections between systems.
- A method for runtime anomaly detection by mining of semantic information about ship movements.
- Strong cooperation between universities resulting in a number of shared publications.
- Over 100 scientific and professional publications and PhD. and MSc. theses.

All partners in the project are satisfied with the results achieved in the POSEIDON project. Some of the results and insights obtained in POSEIDON will find their way in the Thales Netherlands product portfolio. Other achievements have found their way to the portfolio of projects that ESI is executing together with industrial and academic partners, including the successor project METIS, where new research topics are tackled that were instigated by POSEIDON.

I would like to thank all project participants for their commitment and contributions: as a team they have turned POSEIDON into a success! The support of Thales Netherlands and the Dutch Ministry of Economic Affairs (now EL&I) through AgentschapNL is gratefully acknowledged. We also thank Springer for their willingness to publish this book. With this book, we expect to share the important results achieved with a larger, worldwide audience, both in industry and academia.



Eindhoven, September 2012

Prof. dr. ir. Boudewijn Haverkort  
Scientific Director and Chair  
Embedded Systems Institute



# Acknowledgements

*Situation Awareness with Systems of Systems* is a result of the POSEIDON project. The Industry-as-Laboratory project POSEIDON would not have happened without the technological and managerial vision of the Embedded Systems Institute (ESI) and the provision of a “laboratory” inside their company by Thales Netherlands. POSEIDON was partially supported by the Dutch Ministry of Economic Affairs under the BSIK program.

We gratefully acknowledge the cooperation with the employees of Thales Netherlands throughout the 5 years of the POSEIDON project. We are also grateful to the Dutch Coastguard and Marin for providing us with domain knowledge, data, and valuable insights. We thank the employees of our academic partners (Eindhoven University of Technology, VU University Amsterdam, University of Amsterdam, Tilburg University, and Delft University of Technology), Thales Netherlands, Noldus Information Technology, and ESI for writing and reviewing a variety of book chapters. All efforts together resulted in this book that shows the current state of the art in situation awareness with systems of systems.



# Contents

## Part I General

<b>1</b>	<b>Introduction: Situation Awareness, Systems of Systems, and Maritime Safety and Security</b> .....	3
	Jan Tretmans and Pi�erre van de Laar	
<b>2</b>	<b>Improving Situation Awareness in the Maritime Domain</b> .....	21
	Maurice Glandrup	
<b>3</b>	<b>On the Architecture of Systems for Situation Awareness</b> .....	39
	Michael Borth	
<b>4</b>	<b>The POSEIDON Demonstrator</b> .....	55
	Pi�erre van de Laar	

## Part II Situation Awareness

<b>5</b>	<b>Visualization of Vessel Traffic</b> .....	73
	Niels Willems, Roeland Scheepens, Huub van de Wetering, and Jarke J. van Wijk	
<b>6</b>	<b>Extending Track Analysis from Animals in the Lab to Moving Objects Anywhere</b> .....	89
	Wil van Dommelen, Pi�erre van de Laar, and Lucas P.J.J. Noldus	
<b>7</b>	<b>Recognizing Vessel Movements from Historical Data</b> .....	105
	Gerben de Vries and Maarten van Someren	
<b>8</b>	<b>Density-Based Anomaly Detection in the Maritime Domain</b> .....	119
	Jeroen Janssens, Eric Postma, and Jaap van den Herik	
<b>9</b>	<b>Analyzing Vessel Behavior Using Process Mining</b> .....	133
	Fabrizio M. Maggi, Arjan J. Mooij, and Wil M.P. van der Aalst	

**10 The Simple Event Model** ..... 149  
Willem Robert van Hage and Davide Ceolin

**Part III Systems of Systems**

**11 Specification and Generation of Adapters for System Integration** .... 173  
Arjan J. Mooij and Marc Voorhoeve

**12 The POLIPO Security Framework** ..... 189  
Daniel Trivellato, Sandro Etalle, Erik Luit, and Nicola Zannone

**13 Assessing Trust for Determining the Reliability of Information** ..... 209  
Davide Ceolin, Willem Robert van Hage, Guus Schreiber,  
and Wan Fokkink

**14 Online Fault Localization and Health Monitoring for Software  
Systems** ..... 229  
Éric Piel, Alberto Gonzalez-Sanchez, Hans-Gerhard Gross,  
and Arjan J.C. van Gemund

**15 Prioritizing Tests for Fault Localization** ..... 247  
Alberto Gonzalez-Sanchez, Éric Piel, Rui Abreu,  
Hans-Gerhard Gross, and Arjan J.C. van Gemund

**A POSEIDON Project Partners** ..... 259

**B POSEIDON Publications** ..... 261

**Index** ..... 269