

# Lecture Notes in Computer Science

Edited by G. Goos, J. Hartmanis and J. van Leeuwen

1616

**Springer**

*Berlin*

*Heidelberg*

*New York*

*Barcelona*

*Hong Kong*

*London*

*Milan*

*Paris*

*Singapore*

*Tokyo*

Pierre Cointe (Ed.)

# Meta-Level Architectures and Reflection

Second International Conference, Reflection'99  
Saint-Malo, France, July 19-21, 1999  
Proceedings



Springer

## Series Editors

Gerhard Goos, Karlsruhe University, Germany  
Juris Hartmanis, Cornell University, NY, USA  
Jan van Leeuwen, Utrecht University, The Netherlands

## Volume Editor

Pierre Cointe  
Ecole des Mines de Nantes, Computer Science Department  
La Chantrerie, 4, rue Alfred Kastler, BP 20722  
F-44307 Nantes Cedex 03, France  
E-mail: Pierre.Cointe@emn.fr

## Cataloging-in-Publication data applied for

Die Deutsche Bibliothek - CIP-Einheitsaufnahme

**Meta level architectures and reflection** : second international conference, reflection '99, Saint-Malo, France, July 19 - 21, 1999 / Pierre Cointe (ed.). - Berlin ; Heidelberg ; New York ; Barcelona ; Hong Kong ; London ; Milan ; Paris ; Singapore ; Tokyo : Springer, 1999

(Lecture notes in computer science ; Vol. 1616)

ISBN 3-540-66280-4

CR Subject Classification (1998): D.2, D.3, F.3, D.1

ISSN 0302-9743

ISBN 3-540-66280-4 Springer-Verlag Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer-Verlag. Violations are liable for prosecution under the German Copyright Law.

© Springer-Verlag Berlin Heidelberg 1999  
Printed in Germany

Typesetting: Camera-ready by author

SPIN: 10705212

06/3142 - 5 4 3 2 1 0

Printed on acid-free paper

## Preface

This volume constitutes the proceedings of the second conference on Meta-Level Architectures and Reflection (Reflection'99), which will take place in Saint-Malo, France, from 19-21 July 1999.

Upon Reflection'96 held in San Francisco, several workshops organized in cooperation with OOPSLA, ECOOP and IJCAI, the IMSA'92 conference in Tokyo and the founding workshop in Alghero (1986), this year's conference intends to provide a new opportunity for researchers with a broad range of interests to discuss recent developments in the field. Our main goal is to address the issues arising in the definition and construction of reflective systems and to demonstrate their practical applications.

The Reflection'99 programme committee had the hard task of selecting 13 full papers (both research and experiential reports) and 6 short papers out of 44 submissions from all over the world. The selection of papers was carried out during a 1-day meeting at Xerox PARC. The only selection criteria were the quality and originality of the papers themselves. These papers, of both practical and more theoretical bent, cover a wide range of topics including programming languages, systems and applications, software engineering and foundations.

Apart from the presentation of the selected papers, the conference also welcomes John Stankovic, Jean-Bernard Stefani and Yasuhiko Yokote as three keynote speakers.

The success of such an international conference is due to the dedication of many people. I would like to thank the authors for submitting a sufficient number of papers, and the programme committee members and the additional referees for reviewing and selecting the papers contained herein. I would also like to thank Tina Silva and Christine Violeau for organizing the programme committee. Special appreciation goes to Jacques Malenfant, the conference chair, and to Mario Südholt, who was in charge of the electronic paper submissions.

The programme committee members also wish to thank their employers and sponsors for support of these conference activities. Finally, we would like to thank AITO and ACM Sigplan for having provided essential support in organizing Reflection'99.

Ultimately, the success of any conference is measured by the number of attendees who feel they spent their time well. So enjoy the conference and help us to disseminate the idea of open architectures in the software industry.

May 1999

P. Cointe  
Reflection'99 Programme Chair

## Organization

Reflection'99 is organized by the Université de Bretagne Sud and École des Mines de Nantes under the auspices of AITO (Association Internationale pour les Technologies Objets).

## Executive Committee

Conference Chair: Jacques Malenfant (U. de Bretagne Sud, F)  
Programme Chair: Pierre Cointe (École des Mines de Nantes, F)  
US Coordinator: Gregor Kiczales (Xerox PARC, USA)  
Asian Coordinator: Satoshi Matsuoka (Tokyo Institute of Technology, J)

## Programme Committee

Gordon Blair (Lancaster University, UK)  
Gilad Bracha (Sun Microsystems, USA)  
Vinny Cahill (Trinity College, IRL)  
Shigeru Chiba (University of Tsukuba, J)  
Pierre Cointe (EMNantes, F) Chair  
Charles Consel (Irisa, F)  
Jean-Charles Fabre (Laas, F)  
Jacques Ferber (Lirm, F)  
Dan Friedman (Indiana University, USA)  
Lee Gasser (University of Illinois, USA)  
Rachid Guerraoui (EPFL, CH)  
Yutuka Ishikawa (Tsukuba ResearchLab, J)  
Gregor Kiczales (Xerox PARC, USA)  
John Lamping (Xerox PARC, USA)  
Ole Lehrmann Madsen (Aarhus University, DK)  
Jacques Malenfant (Université de Bretagne sud, F)  
Satoshi Matsuoka (Tokyo Institute of Technology, J)  
José Meseguer (SRI International, USA)  
Wolfgang Pree (University of Constance, D)  
Jin des Rivières (OTI Inc., CDN)  
John A. Stankovic (University of Virginia, USA)  
Patrick Steyaert (MediaGeniX, B)  
Robert J. Stroud (University of Newcastle, UK)  
Carolyn Talcott (Stanford University, USA)  
Yasuhiko Yokote (Sony Corporation, J)

## Additional Referees

Jim Dowling	Steven E Ganz	Mayer Goldberg
Julia Lawall	Shinn-Der Lee	Eric Maarsden
Anurag Mendhekar	Gilles Muller	Christian Queinnec
Barry Redmond	Jonathan Rossie	Juan Carlos Ruiz-Garcia
Tilman Schaefer	Kris Van Marcke	Johan Vanwelkenhuysen.
Wilfried Verachtert		

## Cooperating Institutions of Reflection'99



AITO (Association Internationale pour les  
Technologies Objets)  
<http://www.aito.org/>



ACM SIGPLAN (Association for Computing  
Machinery, Special Interest Group in Pro-  
gramming Languages)  
<http://www.acm.org/sigplan/>

## Sponsoring Institutions

Conseil Régional de Bretagne  
Université de Bretagne Sud  
École des Mines de Nantes

Contents

Invited Talk 1

Reflection in Real-Time Systems ..... 1  
    *John A. Stankovic*  
    *University of Virginia , USA*

Programming Languages

From *Dalang* to *Kava* - the Evolution of a Reflective Java Extension ..... 2  
    *Ian Welch, Robert Stroud*  
    *University of Newcastle-upon-Tyne, UK*

Jumping to the Meta Level:  
Behavioral Reflection Can Be Fast and Flexible .....22  
    *Michael Golm, Jürgen Kleinöder*  
    *University of Erlangen-Nürnberg, Germany*

The Oberon-2 Reflection Model and Its Applications ..... 40  
    *Hanspeter Mössenböck, Christoph Steindl*  
    *Johannes Kepler University Linz, Austria*

Meta Object Protocols (MOPs)

Designing Persistence Libraries in Reflective Models  
with Intercession Property for a Client-Server Environment ..... 54  
    *Stéphane Demphlous, Franck Lebastard*  
    *CERMICS/INRIA, France*

Non-functional Policies ..... 74  
    *Bert Robben, Bart Vanhaute, Wouter Joosen, Pierre Verbaeten*  
    *Katholieke Universiteit Leuven, Belgium*

Invited Talk 2

On the Reflective Structure of Information Networks ..... 93  
    *Jean-Bernard Stefani*  
    *France Télécom/CNET, France*



**Middleware/Multi Media**

Reflective Media Space Management Using RASCAL ..... 95  
    *Wayne Robbins, Nicolas D. Georganas*  
    *University of Ottawa, Canada*

The Design of a Resource-Aware Reflective Middleware Architecture ..... 115  
    *Gordon S. Blair, Fábio Costa, Geoff Coulson, Hector Duran,*  
    *Nikos Parlavantzas (Lancaster University, UK)*  
    *Fabien Delpiano, Bruno Dumant, François Horn, Jean-Bernard Stefani*  
    *(CNET/France Télécom, France)*

**Work in Progress (Short Papers)**

A Formal Analysis of Smithsonian Computational Reflection ..... 135  
    *Inge M. C. Lemmens, Peter J. Braspenning*  
    *University Maastricht, The Netherlands*

Reflection for Dynamic Adaptability :  
A Linguistic Approach Using LEAD++ ..... 138  
    *Noriki Amano, Takuo Watanabe*  
    *Japan Advanced Institute of Science and Technology, Japan*

Networking and Reflection: A Strong Combination ..... 141  
    *Frank Matthijs, Peter Kenens, Wouter Joosen, Pierre Verbaeten*  
    *Katholieke Universiteit Leuven, Belgium*

Towards Systematic Synthesis of Reflective Middleware ..... 144  
    *Petr Tůma, Valerie Issarny, Apostolos Zarras*  
    *INRIA/IRISA, France*

An Automatic Aspect Weaver with a Reflective Programming Language .. 147  
    *Renaud Pawlak, Laurence Duchien, Gérard Florin*  
    *CEDRIC-CNAM, France*

Using Compile-Time Reflection for Objects' State Capture ..... 150  
    *Marc-Olivier Killijian, Juan-Carlos Ruiz-Garcia, Jean-Charles Fabre*  
    *LAAS-CNRS, France*

**Invited Talk 3**

Past, Present, and Future of Aperios ..... 153  
    *Yasuhiko Yokote*  
    *Sony Corporation, Japan*

**Applications (Experience Papers)**

Reflecting Java into Scheme .....	154
<i>Kenneth R. Anderson (BBN Technologies, USA)</i>	
<i>Timothy J. Hickey (Brandeis University, USA)</i>	
jContractor: A Reflective Java Library to Support Design by Contract ....	175
<i>Murat Karaorman (Texas Instruments Inc., UCSB, USA)</i>	
<i>Urs Hölzle, John Bruno (University of California at Santa Barbara, USA)</i>	
OpenCorba: A Reflective Open Broker .....	197
<i>Thomas Ledoux</i>	
<i>École des Mines de Nantes, France</i>	
OMPC++ — A Portable High-Performance Implementation of DSM	
using OpenC++ Reflection .....	215
<i>Yukihiko Sohda, Hirotaka Ogawa, Satoshi Matsuoka</i>	
<i>Tokyo Institute of Technology, Japan</i>	

**Meta-Programming**

Metaprogramming Domain Specific Metaprograms .....	235
<i>Tristan Cazenave</i>	
<i>University of Paris 8, France</i>	
Aspect-Oriented Logic Meta Programming .....	250
<i>Kris De Volder, Theo D'Hondt</i>	
<i>Vrije Universiteit Brussel, Belgium</i>	
Author Index .....	273