

**Tutorial proposal for the
23rd ACM Symposium on Applied Computing (SAC 2008)**

Title: Model-driven architecture: core technologies, models and application

Proposers:

Luís Ferreira Pires
University of Twente
PO Box 217, 7500 AE
Enschede, the Netherlands
e-mail: l.ferreirapires@ewi.utwente.nl
Phone: +31 53 4893843
Fax: +31 53 4895477

Marten van Sinderen
University of Twente
PO Box 217, 7500 AE
Enschede, the Netherlands
e-mail: m.j.vansinderen@ewi.utwente.nl
Phone: +31 53 4893677
Fax: +31 53 4895477

João Paulo Andrade Almeida
Departamento de Informática, CT-VII
Universidade Federal do Espírito Santo
Av. Fernando Ferrari, s/n
29060-970 Vitória-ES, Brazil
E-mail: jpalmeida@ieee.org
Phone: +55 27 33352123
Fax: +55 27 33352850

Tutorial proposal for the 23rd ACM Symposium on Applied Computing (SAC 2008)

Title: Model-driven architecture: core technologies, models and application

Lecturers:

Marten van Sinderen
Luís Ferreira Pires
*University of Twente
Enschede, the Netherlands*

João Paulo Andrade Almeida
*Universidade Federal do Espírito Santo
Vitória ES, Brazil*

Duration:

Full-day (8 hours)

Motivation:

The development of distributed applications can be quite complex and normally requires huge investments. In the past, applications that were developed on top of a specific platform became obsolete and had to be replaced whenever a new platform entered and conquered the market. This has inspired the Object Management Group (OMG) to introduce the Model-driven architecture (MDA) approach to the development of distributed applications. The MDA approach applies 'model reusability' as a mechanism to save application development investments. In this approach, one defines abstract models of the distributed applications, which can be specialised and instantiated for different platforms. Such an abstract model is called a Platform-Independent Model (PIM), whereas its platform-specific specialisation is called a Platform-Specific Model (PSM). The translation from a PIM to PSM (for the platform of choice) can be done either by hand or (semi-)automatically using tools. Generic model transformations can be developed to facilitate this translation and enforce correctness. MDA gives structure to the development process of distributed applications and fosters the introduction of modelling standards and tools. MDA can be especially valuable for areas in which applications are developed in an environment of evolving user requirements and platforms.

This tutorial introduces the MDA approach, by giving its motivation and goals, and by identifying its related technologies. This tutorial tackles the MDA technologies, especially the Unified Modelling Language (UML) and the Meta-Object Facility (MOF). This tutorial also discusses the concept of platform and the support for the elaboration of Platform-Independent Models and Platform-Specific Models. Special attention is given to transformations and the transformation specification language being standardised by the OMG, the Query-View-Transformation (QVT) language. Some case studies from the Freeband A-MUSE project (<http://a-muse.freeband.nl>) are presented to illustrate the MDA support currently available and the use of MDA tools.

Target audience:

(Under-)graduate students, application designers, researchers interested in model-based design and distributed systems architectures.

Interest for SAC community:

The SAC community consists of applied computer scientists, computer engineers, software engineers, and application developers. This tutorial can be of great interest for the SAC community, since it addresses topics that enable an increase in productivity, maintainability and correctness of software development,

especially for distributed applications. The topic of this tutorial (model-driven architecture) has received much attention in research in the last couple of years. Some companies have started applying these principles to their products and services, and some benefits can already be observed. We are convinced that the principles and techniques of model-driven architecture should be an integral part of the knowledge background of any computer scientist, computer engineer, software engineer and application developer, and we are committed to conveying this knowledge to the audience.

Outline:

1. Introduction to MDA

This section gives the historical background and motivation for MDA, its goals and an overview of the related technologies. The subtopics of this section are:

- History
- Motivation
- Goals
- Foundations
- Related technologies

2. (OMG) core technologies

This section discusses in more detail the core technologies of MDA, namely UML (including OCL) and the MOF. The subtopics in this section are:

- UML (2.0)
- MOF and EMF (Eclipse Metamodelling Framework)
- OCL

3. Platform-independent models

This section discusses the concept of platform in MDA. It also introduces the concept of abstract platform, which aims at supporting the development of Platform-Independent Models. The development of Domain-Specific Languages as MOF metamodels and the use of these languages to produce PIMs will also be addressed. The subtopics in this section are:

- Platform concept
- Domain-specific languages
- Abstract platforms

4. Transformations

This section introduces and discusses the use of transformation in MDA. Transformations are rather important in MDA to increase the maintainability and correctness of Platform-Specific Models and the productivity and efficiency of the application development process. This section also discusses two transformation languages, namely ATL and QVT (OMG standard in finalisation phase). The subtopics in this section are:

- Transformation concepts
- Transformation languages: ATL and QVT

5. Application example

This section demonstrates the use of the MDA concepts and technologies on examples taken from the Freeband A-MUSE project. This section aims at illustrating how MDA can be applied in concrete application development projects, indicating its benefits and possible drawbacks. The subtopics in this section are:

- A-MUSE Context-aware mobile application
- Transforming application rules into implementation rules

6. Further developments

This section identifies and discusses some areas in which MDA should evolve in the future. The subtopics in this section are:

- Behaviour modelling (Action languages, ISDL)
- Quality-of-Service (QoS) characteristics
- Relationship with ontologies and Semantic Web

Literature (short list):

Douglas Schmidt, "Model-Driven Engineering", *IEEE Computer*, vol 39 (no. 2), IEEE Computer Society Press, February 2006.

Anneke Kleppe, Jos Warmer, Wim Bast, *MDA Explained, The Model Driven Architecture: Practice and Promise*, Addison-Wesley, 2003, ISBN 0-321-19442-X.

Object Management Group, MDA-Guide, V1.0.1, omg/03-06-01, June 2003.
[<http://www.omg.org/docs/omg/03-06-01.pdf>]

Object Management Group, MOF QVT Final Adopted Specification, ptc/05-11-01, Nov. 2005. [<http://www.omg.org/docs/ptc/05-11-01.pdf>]

João Paulo Andrade Almeida, Model-Driven Design of Distributed Applications. Ph.D. Thesis in Computer Science, CTIT Ph.D.-Thesis Series, No. 06-85, Telematica Instituut Fundamental Research Series, No. 018 (TI/FRS/018), Enschede, The Netherlands, 2006, ISBN 90-75176-422.
[https://doc.telin.nl/dscgi/ds.py/Get/File-62786/Model-driven_Design_of_Distributed_Applications.pdf]

Goals/objectives:

This tutorial aims at introducing the Model-Driven Architecture (MDA) approach to distributed applications development. The tutorial stresses the motivation, importance and benefits of the MDA approach. It provides an overview of the concepts, technologies and models that underlie MDA and illustrates the application of this approach with realistic case studies with context-aware mobile applications. The tutorial aims at revealing the strengths and weaknesses of the MDA approach, as well its current stage of development and support.

Expected background:

Knowledge and some experience with software development, especially with object-oriented programming.

Audio-visual equipment: PC, beamer and screen

Lecturers qualifications and expertise:

Marten van Sinderen

Dr. ir. Marten J. van Sinderen (M.Sc. 1982, Ph.D. 1995) is associate professor at the Faculty of Electrical Engineering, Mathematics and Computer Science of the University of Twente. He is also research manager in the area of Service Architectures and Health Applications, on behalf of one of the university's research institutes. His research interests include design methods and architectures for distributed systems, especially integration middleware and information systems. He (co-)organized and chaired several international conferences in the area of distributed systems, including the EDOC Enterprise Computing (EDOC) in 2005.

Publications URL:

http://eprints.eemcs.utwente.nl/view/author/van_Sinderen,_MJ.html

Contact address: University of Twente, PO Box 217, 7500 AE Enschede, the Netherlands

Email: m.j.vansinderen@ewi.utwente.nl

Luís Ferreira Pires

Dr. L. Ferreira Pires (BSc 1983, MSc 1989, PhD 1995) is associate professor at the Faculty of Electrical Engineering, Mathematics and Computer Science of the University of Twente (Enschede, the Netherlands). He has worked in the areas of design methods and architectures for distributed systems, particularly Model-

Driven Architecture and the Semantic web. He is since 2005 co-chair of the Model-Driven Enterprise Information System (MDEIS) workshop (in conjunction with ICEIS), and acts as Programme Committee member of ECMDA, IEEE EDOC, IASTED Telematics, TSOA, VORTE and WEBIST.

Publications URL:

http://eprints.eemcs.utwente.nl/view/author/Ferreira_Pires,_L.html

Contact address: University of Twente, PO Box 217, 7500 AE Enschede, the Netherlands

E-mail: l.ferreirapires@ewi.utwente.nl

João Paulo Andrade Almeida

Dr. João Paulo Andrade Almeida is lecturer at the Computer Science Department of the Federal University of Espírito Santo, Brazil. His current research focuses on the model-driven design of open distributed systems. He has worked in the areas of Model-Driven Architecture, service-oriented design, enterprise architecture and enterprise computing. He serves as a member of the program committee of IEEE EDOC, ACM SAC track on Enterprise Information Systems, IDEAS, WOMSDE and MDEIS, and is a co-chair of the WODPEC workshop at IEEE EDOC 2007. In the past, he has served as a member of the organizing committee of IEEE EDOC 2005, WODPEC 2006, 3M4MDA 2006 and EWMDA 2004.

Publications URL: <http://www.inf.ufes.br/~jpalmeida/cvitaie>

Contact address: Departamento de Informática, CT-VII, UFES, Av. Fernando Ferrari, s/n 29060-970 Vitória, Espírito Santo, Brazil

E-mail: jpalmeida@ieee.org