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## MODA-TEL

### D7.1: Set of scientific publications

### D7.2: Set of contributions to standardisation

### D7.4: Innovation overview and summary report

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### Suggested readers

MODA-TEL consortium partners

European Commission Project Officer

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#### *Abstract*

This document reports the results obtained by the work package on “MDA developments and innovations”. It includes an overview of the scientific publications, as well as an overview of the contributions to standardisation (OMG and ITU-T). Furthermore it provides an overall brief overview of the results of the project.

As such this document collapses three project deliverables in one, namely:

- D 7.1 Set of scientific publications;
- D 7.2 Set of contributions to standardisation;
- D 7.4 Innovation overview and summary report.

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# 1 Introduction

The MODA-TEL work package on “MDA developments and innovations” aimed at addressing the more fundamental questions guided by the results obtained in the other work packages. The objective of this work package was to create new ideas and concepts to further extend MDA technologies and tools to further enable the application in the telecom domain.

This work package was originally structured in terms of the following tasks:

- T7.1: QoS awareness
- T7.2: Modelling behaviour
- T7.3: Business Modelling
- T7.4: Generic Services
- T7.5: Model transformation tools
- T7.6: Recommendation for UML improvements

During the first review some remarks were made that addressing all these topics in the lifetime of the project was a rather ambitious goal, and that the work package should concentrate on a couple of feasible and useful topics. Furthermore, according to the project proposal the other work packages should come up with fundamental questions to be addressed by this work package. This resulted in the following decisions:

- Drop the work on T7.3 and T7.4;
- Work on platform-independence and the concept of abstract platform, as the fundamental questions arose from the application of MDA.

In addition this work package was responsible to co-ordinate the scientific publications, as well as the contributions to standardisation. The following deliverables have been planned in this work package:

- D 7.1 Set of scientific publications;
- D 7.2 Set of contributions to standardisation;
- D 7.3 Innovation prototypes;
- D 7.4 Innovation overview and summary report.

This document corresponds to D7.1, D7.2 and D7.4 and as such it reports systematically on the results of the project. However the scientific publications and the actual text for standardisation are not reproduced here, but are included by reference. Some of the scientific publications are copyrighted by the respective conferences and publishers, but are available for all partner in a secure space on the project Internet server.

This document is structured as follows: Section 2 gives a list of scientific publications; Section 3 summarizes the contributions to standardisation made by MODA-TEL partners; Section 4 introduces the innovation prototypes built within this work package; Finally section 6 gives some additional results obtained within this work package.

## 2 Scientific publications

The following papers have been published:

- [1] J.P.A. Almeida, M. van Sinderen, L. Ferreira Pires. The role of the RM-ODP Computational Viewpoint Concepts in the MDA approach. Workshop on ODP for Enterprise Computing (WODPEC 2004). September 20, 2004, Monterey, California, to appear (in conjunction with EDOC 2004).
- [2] J.P.A. Almeida, L. Ferreira Pires and M. van Sinderen. Costs and Benefits of Multiple Levels of Models in MDA Development. In Proceedings of the Second European Workshop on Model Driven Architecture (MDA) with an emphasis on Methodologies and Transformations (EWMDA 2004). September 7th-8th 2004, Canterbury, England.

- [3] J.P.A. Almeida. Model-driven design of distributed applications. CoopIS/DOA/ODBASE PhD Symposium. Cyprus, 25 Oct - 29 Oct 2004, to appear.
- [4] J.P.A. Almeida, R. Dijkman, M. van Sinderen, L. Ferreira Pires, On the Notion of Abstract Platform in MDA Development. In: Proceedings Eighth IEEE International Conference on Enterprise Distributed Object Computing (EDOC 2004), California, USA, Sept. 2004, to appear.
- [5] J.P. A. Almeida, R. Dijkman, M. van Sinderen, L. Ferreira Pires. Platform-independent modelling in MDA: supporting abstract platforms. In: Proceedings Model-Driven Architecture: Foundations and Applications 2004 (MDAFA 2004), Linköping University, Linköping, Sweden, June 2004, pp. 219-233.
- [6] A. Gavras, M. Belaunde, L. Ferreira Pires, J.P.A. Almeida. Towards an MDA-based development methodology. In: First European Workshop on Software Architecture (EWSA 2004), LNCS 3047. St Andrews, Scotland May 21-22, 2004.
- [7] J.P.A. Almeida, M. van Sinderen, L. Ferreira Pires and M. Wegdam. Platform-independent Dynamic Reconfiguration of Distributed Applications. In: Proceedings IEEE 10th International Workshop on Future Trends in Distributed Computing Systems (FTDCS 2004), Suzhou, China, May 26-28, 2004, pp. 286-291.
- [8] J.P.A. Almeida, M. van Sinderen, L. Ferreira Pires. The role of the RM-ODP Computational Viewpoint Concepts in the MDA approach. In: Proceedings of the 1st European Workshop on Model-Driven Architecture with Emphasis on Industrial Applications (MDA-IA 2004), CTIT Technical Report TR-CTIT-04-12, University of Twente, ISSN 1381-3625, Enschede, the Netherlands, March 2004, pp. 43-51.
- [9] A. Gavras, M. Belaunde, L. Ferreira Pires, J.P.A. Almeida. Towards an MDA-based development methodology for distributed applications. In: Proceedings of the 1st European Workshop on Model-Driven Architecture with Emphasis on Industrial Applications (MDA-IA 2004), CTIT Technical Report TR-CTIT-04-12, University of Twente, ISSN 1381-3625, Enschede, the Netherlands, March 2004, pp. 71-81.
- [10] L. Ferreira Pires, M. van Sinderen, C.R.G. de Farias, J.P.A. Almeida. Use of Models and Modelling Techniques for Service Development. In: M.J. Mendes, R. Suomi and C. Passos (eds.). Digital Communities in a Networked Society: eCommerce, eGovernment and eBusiness, Kluwer Academic Publishers, pp. 441-456, 2004.
- [11] J.P.A. Almeida, M. van Sinderen, L. Ferreira Pires, D. Quartel. A systematic approach to platform-independent design based on the service concept, Proceedings Seventh IEEE International Conference on Enterprise Distributed Object Computing (EDOC 2003), Brisbane, Australia, Sept. 2003, pp. 112-123.
- [12] R.M. Dijkman, D.A.C. Quartel, L. Ferreira Pires, and M.J. van Sinderen. An approach to relate viewpoints and modeling languages. Proceedings Seventh IEEE International Conference on Enterprise Distributed Object Computing (EDOC 2003), Brisbane, Australia, Sept. 2003.
- [13] J.P.A. Almeida, M. van Sinderen, L. Ferreira Pires and M. Wegdam. Handling QoS in MDA: a discussion on availability and dynamic reconfiguration. In: Proceedings of the Workshop on Model Driven Architecture: Foundations and Application (MDAFA) 2003, CTIT Technical Report TR-CTIT-03-27, University of Twente, the Netherlands, June 26-27, 2003, pp. 91-96.
- [14] J.P.A. Almeida, M. van Sinderen, D. Quartel and L. Ferreira Pires. Interaction systems design and the protocol- and middleware-centred paradigms in distributed application development. ECOOP 2003 Workshop on Communication Abstractions for Distributed Systems, Darmstadt, Germany, July 22, 2003.
- [15] J.P.A. Almeida, L. Ferreira Pires and M. van Sinderen. Web Services and Seamless Interoperability. ECOOP 2003 European Workshop on Object Orientation and Web Services, Darmstadt, Germany, July 21, 2003.
- [16] J.P.A. Almeida, M. van Sinderen, L. Ferreira Pires and D. Quartel. The role of the service concept in model-driven applications development. Middleware 2003 Companion: Proceedings of the Workshop on Model-driven Approaches to Middleware Applications Development (MAMAD) 2003 at the

ACM/IFIP/USENIX International Middleware Conference 2003, Rio de Janeiro, Brazil, June 2003, pp. 288-296.

- [17] Farshchian, B.A., Jakobsson, S., Berg, E.: Coupling MDA and Parlay to increase reuse in telecommunication application development. Paper presented at UML'2002 Workshop on Software Model Engineering, Dresden, Germany. Oct. 2002.
- [18] Farshchian, B.A., Jakobsson, S., Berg, E.: Coupling MDA and Parlay to increase reuse in telecommunication application development. Paper presented at ECOOP'2002 Workshop on Model-based Software Reuse, Málaga, Spain. June 2002.

The MDA-IA 2004 workshop proceedings have been edited in the scope of MODA-TEL :

- [19] M. Van Sinderen, L. Ferreira Pires (eds.). Proceedings of the 1st European Workshop on Model-Driven Architecture with Emphasis on Industrial Applications (MDA-IA 2004), CTIT Technical Report TR-CTIT-04-12, University of Twente, ISSN 1381 - 3625, Enschede, The Netherlands, March 2004, pp. 43-51.

### 3 Contributions to standardisation

France Telecom has been involved in two domains which have a direct relationship with the work achieved in the MODA-TEL project:

1. Standardisation of a design notation for voice-interactive dialogs.

In 2003, France Telecom has proposed the issuance of a new RFP to address the need for a standard notation to be used to design voice dialogs independently of the implementation platform (UML Profile and metamodel for voice-based applications). The RFP was drafted and presented by France Telecom to the Telecom Task Force at the end of 2003, and then it was endorsed and issued by the Architecture Board in February 2004. This RFP asks for the definition of a metamodel to represent voice specific concepts and asks for the definition of a UML profile to be used as the graphical concrete notation.

In August 2004, France Telecom has presented an initial submission for this RFP, with support from IBM, Alcatel, Telelogic and Softeam. This initial submission is mainly based on the results of MODA-TEL on VoiceXML use case.

The work toward the standardisation of UML for Voice Based Applications is documented at the OMG web, specifically the following URLs are relevant:

[http://www.omg.org/techprocess/meetings/schedule/UML\\_for\\_Voice\\_Based\\_Apps\\_RFP.html](http://www.omg.org/techprocess/meetings/schedule/UML_for_Voice_Based_Apps_RFP.html)

<http://www.omg.org/cgi-bin/doc?telecom/04-02-03> (Request for Proposals document)

<http://www.omg.org/cgi-bin/doc?mars/04-07-07> (Joint Initial submission to the UML for Voice-based Applications RFP)

2. Standardisation of the model to model transformation language.

France Telecom led the French OpenQVT consortium that made one of the 8 initial responses submitted in March 2003 for MOF 2.0 Q/V/T standard. The revised submission was presented in October 2003. Within this submission, France Telecom proposed the TRL language, a kind of imperative OCL extension, to express transformation definitions. This language has been used in the MODA-TEL's VoiceXML use case to define the transformation between the UML model of a voice service into the model representing its implementation on top of the EUPHONIE platform.

In 2004 France Telecom has actively contributed to the creation of the MergeQVT submission team, which groups almost all initial submitters in the preparation of a common joint response. The MergeQVT response will be submitted in October of this year and adoption is planned to occur in February of next year.

The work towards the standardisation of the MOF 2.0 Query/View/ Transformations RFP is documented at the OMG web, specifically the following URLs are relevant:

[http://www.omg.org/techprocess/meetings/schedule/MOF\\_2.0\\_Query\\_View\\_Transf\\_RFP.html](http://www.omg.org/techprocess/meetings/schedule/MOF_2.0_Query_View_Transf_RFP.html)

<http://www.omg.org/cgi-bin/doc?ad/02-04-10> (Request for Proposals document)

This Request for Proposal (RFP) is one of a series of RFPs related to developing the next major revision of the OMG Meta Object Facility specification, which will be referred to as MOF 2.0. Some of the RFPs pertain to specifying the technology neutral MOF itself, while others pertain to mapping the MOF to specific implementation technologies. This RFP addresses a technology neutral part of MOF and pertains to:

1. Queries on models.
2. Views on metamodels.
3. Transformations of models.

Currently different submissions are available and discussion is ongoing for reaching an agreement on a single standard that would represent the industry consensus. Submissions in which project partners have contributed are:

<http://www.omg.org/cgi-bin/doc?ad/03-08-05> (Joint submission by the OpenQVT consortium. Mr. Belaunde, France Télécom is editor)

<http://www.omg.org/cgi-bin/doc?ad/03-08-11> (Joint submission by Interactive Objects and Project Technology Inc., editor is Mr. Jens Rommel, Interactive Objects)

3. Finalisation Task Force (FTF) for the UML super- and infra-structure standard. Philippe Desfray, Softeam is member of the relevant finalization task forces. The work of these task forces is documented at the OMG web, specifically the following URLs are relevant:

[http://www.omg.org/techprocess/meetings/schedule/MOF2-UML2\\_Infrastructure\\_FTF\\_2.html](http://www.omg.org/techprocess/meetings/schedule/MOF2-UML2_Infrastructure_FTF_2.html) (MOF2-UML2 Infrastructure FTF 2), and

[http://www.omg.org/techprocess/meetings/schedule/UML\\_2.0\\_Superstructure\\_FTF\\_2.html](http://www.omg.org/techprocess/meetings/schedule/UML_2.0_Superstructure_FTF_2.html) (UML 2.0 Superstructure FTF 2).

4. ITU-T Study Group 17 on Data Networks and Telecommunication Software.

The project drafted text (submitted by Anastasius Gavras, Eurescom/Deutsche Telekom AG) to recommend the following to the study group:

In summary the following is concluded from the attached project MODA-TEL deliverable document:

The project MODA-TEL (IST-2001-37785) co-funded by the European Commission under the 5th framework programme for research and technological development, has considered the relation of ITU-T languages in the context of the OMG Model Driven Architecture (MDA).

New model-engineering techniques are becoming widely used in the software and systems development industries. The available tool support in the market is increasing. In order to take advantage of future wide availability of tools, it is recommended that ITU-T languages become meta-model based.

eODL is already meta-model based and thus complies with the main conceptual basis of MDA. It is recommended that also the other ITU-T languages evolve towards the same type of formalisation.

Specifically for:

- ASN.1: define a meta-model, possibly derived from the existing XML schema
- SDL and MSC: define a meta-model possibly re-using relevant parts of the UML 2.0 meta-model
- TTCN: define a meta-model for TTCN and consider alignment with the UML testing profile
- URN: define a meta-model for both GRL and UCM, that is not influenced by graphical-notation concerns.

The contribution is registered on the ITU-T document repository as COM 17 – D 150 – E.

## 4 Innovation Overview and Summary report

The following areas for innovation have been mentioned in the MODA-TEL project proposal:

1. Methodology (methods, techniques, guidelines and transformations): these issues have been tackled by the work package on “Architecture, Methodology and Guidelines“ (WP3).

2. Application (MDA application, specialisation and validation in the telecom domain): these issues have been tackled by the work packages on “Domain specific applications of MDA – Problem descriptions and concepts” (WP4) and on “Experiments of the use cases” (WP6);
3. Tools (tool support and architecture): these issues have been tackled by the work package on “MDA Based Toolset” (WP5);
4. Research, standardisation and dissemination: these issues have been tackled by the work packages on “MDA developments and innovations” (WP7) and on “Exploitation and Dissemination of Results” (WP1).

The innovation achieved by MODA-TEL in each of these areas is further discussed in the sequel, in terms of the deliverables that embody the major achievements in each area.

## 4.1 Methodology

Deliverable 3.3 discusses the formalization principles in the broad context of an MDA methodology. It concentrates on how a Platform Independent Model (PIM) and a Platform Specific Model (PSM) can be defined as well as how transformation rules for transformations from PIM to PIM, PIM to PSM, PSM to PSM and PSM to platform can be defined and supported. It also discusses how traceability can be managed within the lifecycle of service and application development following the MDA approach.

Deliverable 3.4 identifies the relationships and dependencies between the technologies and standards and describes the core ingredients that could lead to a deployable model-driven architecture. In view of a specific MDA development methodology it is necessary to emphasise the important role of tools and tool chains supporting a model based development methodology. The future of MDA tools is closely related to the future of application development in general. Several evolution paths and trends can be observed in the industry, ranging from Integrated Development Environments (IDE) to very specialised tools. In any case the tool support for MDA is very likely to be quite comprehensive in the near future. Furthermore, this document defines a series of criteria to evaluate to which extent the currently available tools support MDA. A brief description of these tools is given, as well as their evaluation according to identified criteria.

Deliverable 3.5 outlines the model driven methodology developed by, and adopted in the MODA-TEL project. This methodology provides definitions of the used concepts, the identification of phases and individual activities, and their interrelationships in a model driven software development process. Model-driven development is an approach to the development of systems that applies model reusability as a mechanism to save development investments. While the Model Driven Architecture (MDA) describes methods and techniques for model driven software development, it does not define a methodology as *a body of interrelated methods and rules*. Furthermore the MDA methods and techniques are not explicitly related to identifiable activities within software development processes.

## 4.2 Application

Deliverables D4.1 and D6.1 discuss the three use cases that have been selected for implementation:

1. The “QoS-aware video service” has been selected because of its aspect-oriented requirements. Aspect oriented modelling is quite a new research field that is highly suitable to challenge the MDA approach. Additionally this use cases fulfils most of the selection criteria required.
2. The “Voice applications based on voice XML” and “Parlay service development” have been combined in a single use case. This extremely complex scenario is of high relevance for the Telco domain involving several aspects identified in the MDA paradigm.
3. The “Customer and Service Management” use case also fits properly the selection requirements. Furthermore, this use case has been implemented by developers not exposed before to MDA. By this experiment the project team expects have gained insight in the impact the new approach and methodology has on MDA-unaware developer teams.

Deliverable D4.3 provides details of the applied MDA concepts towards the realisation of the MODA-TEL use cases. For each of the three use cases an agreed template has been applied to capture the details of the process. The applied steps that constitute parts of the methodology include:

- Definition of a suitable meta model for the specific use case domain
- Definition a concrete notation for the PIM modelling
- Platform description defining the platform dependent meta-data
- Definition of a notation for platform specific models
- Definition of the overall transformation process
- Definition of PIM to PSM mapping rules
- Development of the code generator

The work described in D4.2 actually applies the results reported in other MODA-TEL deliverables concerning a methodology to be followed. After these steps have been accomplished a specific tool or tool chain can be chosen that will support the engineering implementation of these use cases.

Deliverable D4.3 document how the Model Driven Methodology developed in the MODA-TEL project was applied for the implementation of the identified use cases. D4.3 reflects on the activities that need to be performed and how the tools used by the project partners are supporting these activities. Wherever needed required extensions to the tools are discussed.

Finally deliverable D6.3 documents the experience from the implementation of the use case following the MDA approach and in particular the MODA-TEL methodology.

### **4.3 Tools**

Deliverable 5.1 identifies basic capabilities that MDA tools need to fulfill in order to be generally applicable and in the context of the MODA-TEL project to be applicable to telecommunications domain specific use cases in particular. Furthermore it formulates a vision for a flexible MDA tool framework that might evolve into a “developer operating system”, supporting plug-ins as extensions covering specific functionality regarding any MDA aspect as well as aspects of target platforms.

Deliverable 5.2 and 5.3 are the tool prototypes delivered to the project for being used in the use cases.

### **4.4 Research, standardization and dissemination**

The research in the MODA-TEL project has focused on the design methodology, allowing innovation results from this work package to be directly applied in the other work packages. Some topics addressed in the published scientific papers are, amongst others, the service concept [11,16], platform-independence and abstract platform [4,5], QoS (availability and reconfiguration) [7,13], development process [3,6,9,10], abstract platform and the relationship with (ODP-RM) viewpoints [1,8,12].

The standardization innovation has been targeted to the contributions to the QVT RPF and the Voice XML standardization reported in section 3.

## **5 Demonstrators and prototypes**

The University of Twente has developed a demonstrator on the use of marking to assist the generation of models and code from platform-independent models. The work is documented in a separate document which has been produced as Deliverable D7.3 accompanying documentation.

## **6 Additional results**

The following additional results have been obtained in the scope of the work package on “MDA developments and innovations”:

- QoS internal document produced as input for QoS case study of WP4

- M.J. van Sinderen, L. Ferreira Pires. Model-driven architecture: core technologies, models and application. Invited tutorial at the 3rd IFIP Conference on E-commerce, E-business and E-government (I3E 2003), São Paulo, Brazil, September 21-24, 2003.
- Graduation reports
  - Jan-Willem Janssen. Evaluation of current tool support for the Model Driven Architecture, MSc thesis. University of Twente, the Netherlands, January 2004.
  - David Baakman. A model-driven approach to the control and management of audio and video streams, MSc thesis. University of Twente, the Netherlands, October 2003.
  - Niels Backx. Model Driven Architecture for Web services applications, BSc thesis. University of Twente, the Netherlands, March 2004.
- Student project reports and thesis supervised by Telenor R&D
  - Tom Vasset, Tor Einar Lyngset, Fag: Systemutvikling, Datateknikk Thesis title: Coop. Tech – MDA (Model Driven Architecture)
  - Henriette Abrahamsen, Project title: Model Driven Architecture (MDA) og teletjenester

Also Telenor, having a close co-operation with the University of Trondheim (<http://www.ntnu.no>), has supervised project work and student theses within the fields of MDA. The students have evaluated MDA tools and have conducted practical work using these tools and creating demonstration services on Telenor's networks. Conclusions of these works have been used in the context of MODA-TEL.