Technical Architecture of the Digital Business Ecosystem Project

Pierfranco Ferronato
DBE Chief Architect
pferronato@soluta.net

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Fostering the Research and Technological Development, the DBE Project is an Integrated Project presented under the first call of the VI EU Framework Programme. The initial activities have started in November 2003.
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Note about the Author

- Pierfranco Ferronato is the Chief Architect and founder of Soluta.net. He has over 15 years of experience in all aspects of distributed systems development and is internationally recognized as an expert in large-scale architectures and object-oriented/component development. Dr. Ferronato has provided technical and architectural leadership for several European projects using advanced Internet-related technologies, component-based development, web services and wireless technologies in a number of domains, including telecoms, pharmaceutical, CRM, EAI and tourism. He is an active member of the OMG and a frequent speaker at conferences worldwide.

- Soluta.net is constituted by a team of IT professionals that have a worldwide experience in Component-Based Development and Enterprise Architectures. They have provided technical and architectural leadership for several European projects using advanced Internet-related technologies, component-based development, Web Services and wireless technologies in a number of domains, including telecoms, pharmaceutical, CRM, EAI and tourism.
Assumptions

- Even if this presentation has a rather technical “style”, and it is aimed at technical people and project leaders with some MDA skills, it is valuable also for a non-technical audience.
- We assume participants have followed the previous presentations, even though a summary will be given.
- Given the complexity of the project and the small time-frame available, it has been necessary to simplify some detail of the architecture and of its components but it is still coherent and correct.
- The main objective is to present this very challenging project and to describe how MDA has been leveraged.
Digital Ecosystem

J.F. Moore describes a Business Ecosystem as “An economic community supported by a foundation of interacting organizations and individuals - the organisms of the business world. This economic community produces goods and services of value to customers, who are themselves members of the ecosystem. Over time, they co-evolve their capabilities and roles, and tend to align themselves with the future directions...” (J.F Moore, The Death of Competition, 1996, pag.6-7)
Project Consortium and Organization

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The Project

- Integrated Project funded under the Networked Business and Government strategic objective
- Duration: 3 years [+ 1 optional]
- 150 man/year of work, more than 40 person full time, 110 in total
- 20 partners, 9 Member States, 5 Regions involved directly
- 10.5 M€ funding
- The DBE is one of the largest EC research investment ever in F/OSS in ICT for e-business (100% of results delivered to the public domain)
Partners

- Censis (Italy)
- FZI-Research Center for IT (Germany)
- IBM (Belgium)
- IESE (Spain)
- Intel (Ireland)
- Imperial College (Great Britain)
- London School of Economics (Great Britain)
- Salzburg Technical University (Austria)
- Soluta.net (Italy)
- Sun (Spain)
- T6 (Italy)
- Trinity College Dublin (Ireland)
- University of Birmingham (Great Britain)
- University of Crete (Greece)
- University of Lecce (Italy)
- University of Surrey (Great Britain)
- Waterford Institute of Technology (Great Britain)

+ Several Regions from Italy, Spain, Great Britain, Finland,...
Project Time scale

DBE 1st release  

Phase 1 (1-18 Months)  

Nov 2003

DBE Sw available

Phase 2 (19-36 Months)

April 2005

DBE operational

Nov 2006
“It is not the strongest of species that survive, nor the most intelligent, but the one most adaptable to change.”

Charles Darwin
1809 - 1882

We are creating ‘digital Darwinism’: a digital environment that is able to evolve as the users need it to.
Role of MDA
Need for a Model Driven Architecture

- DBE has a plethora of languages/meta-models
  - Ontology, Business models, Business rules, Regulatory frameworks, Computational dependent models, Test frameworks
- DBE needs Model transformation
- DBE needs Code Generation
- We cannot avoid creating a meta-modelling platform if we want to achieve interoperability
  - Inter DBE For Structural components
  - External for reusing/importing foreign models
  - Intra DBEs
- Enforcing separation CIMs-PIMs-PSMs
- Aims at CIMs->PIMs->PSMs (Code)
Languages

- Ontology
- Legal Regulatory
- Business Modeling Languages (BML)
  - CIM description of the business side of firms
  - DBE project requires a business modelling language to represent the business organization, its products and services, contractual basis and basic IT infrastructure and to model business service descriptions
  - The BML contains information like: service offered and requested, resources, processes, business model and motivation, policies and agreement, location and event related to business and so on.
- Service Description Language (SDL)
  - PSM description of a service
  - The SDL describes the technical specification of a DBE service.
  - The SDL is able to describe the DBE service in a double-faceted fashion. One facet refers to the Semantic Description of DBE Services and the other refers to the description of the DBE Service Interaction Specification.
  - SDL is a semantically rich abstraction of the WSDL.
MDA Stack

(M0) Information

(M1) CIM & PIM Models

(M2) CIM & PIM Meta models (BML, SDL, Ontology, Legal Regulatory...)

(M3) “The” MOF Model
MDA-based Knowledge Representation in DBE

“The” MOF Model

Ontology Definition Meta-model

Meta-model Integration

BML Meta-model
SSL Meta-model
SDL Meta-model

Service Model

Domain Ontologies

Reference

BML Models
SSL Models
SDL Models

Published Service Manifest

BML Models & Data
SSL Models & Data
SDL Models

BML Data
SSL Data
OMG Business Modelling Architecture

- Business Authority & Handoffs of Responsibility
- Business Schedules & Times
- Business Organization
- Event
- Location
- Business Locations
- Business Vocabulary
- Business Domain
- Business Constructs
- Business Processes
- Business Motivation
- Business Motivation & Guidance
- Digital Business Ecosystem

DBE Architecture
Environments

- **Service Factory Environment**
  - Where services are described and developed
  - Business modelling (CIM), Computational modelling (PIM), Java coding (PSM), test, distribution, deployment,

- **Execution Environment**
  - Where services are discovered, retrieved and executed
  - Contains a smart proxy deployment sub-system
  - Contains a Servent (DBE Application Server, SERVer + cliENT)

- **Evolutionary Environment**
  - A parallel environment where service chains are created and optimized
  - Push approach
  - Testing harness
Components layout

Execution Environment

- Information Carriers
- Payment
- Recommender
- Accounting
- Distributed Registry
- Browse/Execute
- Servent
- Fitness
- Identity Mgn
- P2P Network

Service Factory Environment

- Composer
- Service Chains
- BML Realm
- Intelligent Systems
- SDL Realm
- Service (PIM)
- Authoring Tool
- Service Info.
- BML Realm
- Service Modeler (CIM)
- Domain Ontologies
- Ontology
- Legislations
- Framework
- Models
- Knowledge Base

Execution Environment

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The Service Manifest

- Service Manifest
  - PIM of a Service
- It contains
  - Complete representation of a Service
  - Business models + computational model + Information
  - Reference to 'foreign' ontology
  - XMI encoding of the models
**Service Proxy**

- Technical Architecture
- Smart proxy
  - Serializable Java imperative code
  - Run-time distributed
  - Concept borrowed from Jini
- End-point mediator
- It keeps a reference to its Service Manifest
- DBE will allows a non-Java proxy to take advantage of the ecosystem
The XMI nature of the service manifest will allow the DBE Servent to be able to dynamically generate the proxy.
Service Composer

- Service definitions defined at composition-time
- Real services binded at runtime

Diagram:

- Book gig
- Book Departure flight
- Book Return flight
- Book Hotel Accommodation
- Inform user
- Ask user
- User reply
- Cancel
- Overbooked
- No availability
- Conclusion
What about web services?
What about Web Services?

- **WSDL**
  - does not bring semantic, purely computing interface
  - No business, service information
  - Represent end-point

- **UDDI**
  - represent a single point of failure, does not scale
  - Unstructural information

The model SOAP/WSDL rely on the concept of “reaching an end point”
- The client application is left alone with the hard
What about Web Services?

- Publishing a service endpoint using WSDL and a DHCP/NAT’d IP address does not work

- When a Service is unavailable:
  - Static Description of Service is no longer available
  - Customers trying to use an unavailable service do not know whether you’re out of business or just out of order

- Service Manifest (the service static description) is always available
  - Service Manifest and Proxy storage media are decoupled

- Proxy (the service dynamic representation) is available only when the service is available
  - Services are leased in a P2P when the resources/end-point is available on a SME PC

- Customers trying to use an unavailable service now know if you are out-of-business or just out-of-order

Courtesy of Trinity College
The Knowledge Base
(DBE MOF Repository)
Evolutionary model repository...

- The DBE does not want to over-impose a reference model for both business and computation
  - Previous EU projects failed here
  - No DBE Committee for model management
  - “Let the market decide”
  - “As fast as the market”
- A more convenient service BUT with a different SDL over the current will create inertia in the adoption
  - Example scenario
- Effective models will be reused over and over
- Models can be enhanced and “evolve” to address the market more closely
- We expect that services pertaining to the same domain will naturally converge to cluster of models
It is not as easy

- The critical mass is “critical”
  - How many SME users are needed?
  - Which is the critical mass?
- It takes a long time to converge
  - Will it converge?

- Data model and service interfaces are not over-imposed (e.g. ebXML)

- It is a shift in Repository Management
Repository features

- Redundant, similar and equivalent models are acceptable
  - Same tag, different semantics
  - Different tag, same semantics
- Inheritance and deletion is not allowed, modification means a replication first
- It is neither a hierarchical data model nor a taxonomy, it is more similar to a mesh
- Models will binded with one ontology (or more)
- It is strategic to be able to tell how models are different or similar
  - Ontology
  - Model dependency
  - Similarity distance
- What about interoperability?
  - Data mapping, model transformation
  - MDA helps in here
MOF Repository Reference Architecture

- Ontology Editor
- BML, SSL, SDL Editors
- Service Composer

- Proxy
- Ontology API
- BML API
- SSL API
- SDL API

- MDR API (Import/Export XMI)
- JMI API
- NetBeans MDR

- Recommender, Dependency mng Modules

- Java RDBMS
MDA in the Project
MDA Based test in the DBE

MOF Test Generator "generator"

BML Metamodel

Test generator

Test Cases

Unit Test

Test results

depends

uses

generates

depends

depends

uses

generates

uses

generates

m0

m1

m2

m3
Achievements

- MDA a founding principle that is bringing great advantages in the project
- We constantly refer to MDA, OGM standards and MOF models as a common framework and approach to interoperability
- We reuse and provide value-added to Open Source projects
- “we are not alone out there”
MDA, “the silver bullet”?

Yes yes...

BUT

The standards are not stable yet, different communities are doing their way with XMI/MOF bases repositories
  - Netbeans MDR (SUN), Eclipse EMF (IBM), UML Editor XMI import/export feature very feeble
Modeling Tools and MOF repositories are in their early stages: lacks of documentation
Modeling Tools and MOF repositories are barely interoperable
A Lot of XMI misconception out there
OMG is moving from MOF1.4 to MOF2.0
OMG is moving from XMI1.2 to XMI.20
Hurdle example

- MDR is a OSS project of Netbeans that aims at providing a MOF-compliant repository (JMI implementation)
- EMF is an OSS project of the Eclipse Foundation that aims at being a Java MOF-compliant model editor generator
- BUT MDR is MOF1.4 based while EMF is Ecore based (which is a 'lite' non-OMG meta-model language: )
  - Integration is a barrier
  - This dichotomy is creating a diaspora
- EMF is not JMI-compliant
- Will XMI/MOF 2.0 take peace or increase the hurdles?

- Poseidon and other UML-based editors assert to be able to export XMI
- BUT XMI is not just an encoding, the meta-model used for exporting the model is different in the version and sometimes it is even proprietary
  - As a consequence cross-compatibility is a chimera
MDA Current Shortcomings

- No model dependencies
- Symbol semantics
- Foggy forest of versions:
  - XMI Unisys, XMI 1.0, 1.1, 1.2, MOF 1.4 (MOF 2.0 is applied even if it is not yet a public RFP), UML 1.3, 1.4, 1.5 (MOF 2.0 is applied even if it is not yet a public RFP)
- Except CORBA, there is no distributed MOF interchange interface
  - Missing a Web Service Meta-model Interchange specification
  - This would accelerate the development of distributed MOF repositories
- Missing MDA testing specification
The MDA “wishing well”

- OMG specifications:
  - Query/View/Transform (QVT)
  - MOF Model to Text Transformations (and back, with annotations)
  - MOF2.0, UML2.0
  - MOF Versioning
  - Ecore convergence

- There is no strict compliance with OMG standard out there
  - No validation process (W3C does provide validators)
  - Need for a clear "MDA product standard definition"
  - It is hard to tell the quality of MDA compliance in tools
  - A simple set of rules is needed to help users and vendors decide which tools really implement MDA or part of it.
Questions?
More Information

- **Official Web Site**
  - [http://www.digital-ecosystems.org](http://www.digital-ecosystems.org)

- **EU Project Officer**
  - [http://www.nachira.net/de/index.htm](http://www.nachira.net/de/index.htm)

- **Paper "Pervasive Service Architecture for a Digital Business Ecosystem"**

- **Paper "Toward a Semantically Rich Business Modelling Language for the Automatic Composition of Web Services"**
  - [http://www.ebrc.info/kuvat/2072.pdf](http://www.ebrc.info/kuvat/2072.pdf)

- **DBE Paper by the EU**

- **Project Summary**
  - [http://www.ee.ic.ac.uk/philippe/dbe_summary_cc.pdf](http://www.ee.ic.ac.uk/philippe/dbe_summary_cc.pdf)

- **IST Project Fact Sheet**