Reuse and Migration of Legacy Systems to Interoperable Cloud Services

REMICS Consortium
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Project facts

- REMICS is a STREP accepted in the Objective 1.2 of FP7 Call 5 (Internet of Services, Software and virtualization).

- REMICS runs from September 2010 for 3 years. The original budget is 4.5 MEuro.

- Current partners are:
  - SINTEF, DI Systemer (Norway)
  - Softeam, Netfective Technology (SMEs from France)
  - Fraunhofer FOKUS (Germany)
  - ESI (Tecnalia), DOME Consulting and Solutions (Spain)
About roles

- SINTEF is the coordinator of the project.
- I work as research scientist in SINTEF and have taken over the coordinator role. I also teach at university (NTNU).
- We perform research on cloud computing, SOA modeling, interoperability, methodology and empirical studies.
- Other partners roles:
  - Netfective: recovery with BluAge tool
  - Softeam: SOA and modeling with Modelio tool
  - Tecnalia (ESI): methodology and integration
  - Fraunhofer FOKUS: model-based testing
  - DOME and DISYS: SMEs with use cases
REMICS Enlarged EU

- In negotiation phase, extended budget is 870 000 Euro.
- Assuming start on September 1, 2011.
- The new partners are:
  - Warsaw University of Technology (Poland) – WU. Focus on requirement-based recovery and migration
  - University of Tartu (Estonia) – UT. Focus on scientific applications and cloud performance
  - Institute of Information and Communication Technologies – Bulgarian Academy of Sciences (Bulgaria) – IICT-BAS. Focus on agile methodologies.
Problem to be addressed

- Legacy systems are most of the times of substantial value for companies:
  - They still function for the users’ needs;
  - They capture important business logic;
  - The cost of replacing them with systems designed from scratch is often too high.

- However:
  - Legacy systems are often difficult to reuse due to platform, documentation and architecture obsolescence.
  - Legacy systems are facing critical issues: need to change but do not know how.
  - New technologies arrive such as **Cloud Computing** and **Software as a Service (SaaS)** that promise better performance or cost saving that motivate organizations to modernize their applications.
Challenges

- The oldness degree of technologies to be reversed;
  - How to adapt them to the SaaS and cloud paradigms?
  - How to handle interoperability?

- The absence of knowledge;
  - How to extract business value information?

- QoS should be preserved;
  - Performance of heavy loaded and critical applications;
  - How to reuse legacy systems in automated testing of the new SaaS?

- Cost of the migration process;
  - How to plan a progressive migration process?
  - How to train people in new technologies such as MDE, service engineering etc.?
REMICS approach; main points

- Model-driven engineering techniques;
  - Models to capture legacy and transforming them into SOA and cloud deployment;
- Automatic or semi-automatic recovery and migration;
- Service engineering based on SoaML;
- Modernizing by service composition, applying patterns and SaaS concept;
- Standardizing the results
  - Open models and metamodels
Steps in the REMICS approach

- Migrate
  - Model-Driven Interoperability
  - Target Architecture For Service Cloud Platform
  - Forward MDA Through PIM4Cloud
  - Service Cloud Implementation

- Source Architecture
  - Recover
  - Validate, Control and Supervise
  - Legacy Artefacts
Recover

- Input is source code, documentation, execution logs, people’s knowledge.
  Output is models: requirements, architecture, business processes and rules, implementation and deployment models, etc

- Analyse feasibility of the modernization strategies and select one or multiple:
  - Automatic extraction
  - Computer assisted extraction
  - Annotation driven extraction
  - Refactoring at the PIM level
  - Paradigm change: from Delphi t for Java for example
  - Usually code is migrated to XML type of data vs algorithmic
Recover - Continue

■ Recover business value information:
  ■ Requirements, processes, rules, non-functional properties etc.
  ■ Separation of concern:
    ■ Business code vs technical code
    ■ UI/service/Batch/Report/data

■ We use the OMG KDM standard and extend it when necessary.

■ BluAge tool from Netfective is the recovery tool.

■ WUT will focus on recovery of requirements in RSL (CIM level) and using these in migration and testing.
The four step recovery process
Migrate

- The purpose is to start from the legacy models and modernize them to build the new a new SOA by applying methods such as decomposition, component wrapping and replacements.

- Migrated models will be in SoaML with link to business models. Modelio tool from SOFTEAM is used for modeling.

- Some components or services may be replaced by newly discovered ones.

- SOA and cloud computing patterns are to be applied.
Migrate - Continue

- Forward engineering for adding new functionality;

- Deployment in Cloud:
  - PIM4Cloud or CloudML planned as an abstraction of cloud computing platforms and a language for modeling deployment in cloud.
  - Initial focus is on IaaS aspects, but we are also interested in PaaS.

- Model transformation from these models to cloud platforms.

- Standardising RSL within the OMG as a language for semantically precise requirements.
What is SoaML?

- Service oriented architecture Modeling Language (SoaML)
- Defines language constructs and extensions to UML2 to support service concepts (metamodel and UML profile)
- Focuses on basic service modelling concepts and structure.
- A foundation for further extensions and integration with BPMN, BMM and other metamodels.

Key language constructs

- Consumer
- MessageType
- Participant
- Provider
- ServiceContract
- ServiceInterface
- ServicesArchitecture
Cloud models and languages

We are currently looking at some interesting models and languages:

- **Amazon Cloudformation**
  - a textual description language for cloud resources

- **CA 3Tera AppLogic**
  - a graphical language for Cloud configuration

- **Elastra – with DSLs for Cloud configuration**
  - Elastra Cloud Modeling Language (ECML) is used to describe an application (software, requirements, and policies)
  - Elastra Deployment Modeling Language (EDML) is used to describe the resources (virtual machines, storage, and network) available in a data center.
  - [www.elasta.com](http://www.elasta.com)
Analysis of PaaS and IaaS solutions

We have identified parameters for this evaluation:

- Services they provide:
  - service level, delivery model, license type, business model etc.
- Architectural issues:
  - security, load balancing, storage, fault tolerance etc.
- User interface:
  - API, programming framework

We have compared some cloud computing technologies based on the above parameters.
Manage Interoperability

- The legacy system may be enhanced by adding new services or services may be composed in new ways.

- Model-driven interoperability helps in adapting services using *mediators*.

- Mediators or mediation services take input data in one format and provide it in another format.

- We plan to extend SoaML (SOA modeling language) with data format models and behavioral model for mediation.

  - **PIM4ServiceInteroperability**
The first release: B2B data mapping

Mapping metamodel
Validate

- The recovered architecture should correspond to the legacy system;
- And provide the same or better QoS, business goals, coverage, etc.
- Recovered models should be used in the validation process based on model-based testing techniques.
- The original system can act as a test oracle since requirements may not be well captured.
- Static model analysis and MBT will involve OCL (Object Constraint Language) and U2TP (UML2 Testing Profile)
Control and supervise

- The goal is managing applications by observing them and performing corrective actions.

- Models@runtime for self-managability is one possible technique to use.

- UT will work on performance prediction and monitoring with different configurations on cloud infrastructure.
REMICS methodology

The purpose of methodology is to guide the users on how to apply REMICS methods and tools during recovery and migration.

This includes:
- feasibility analysis,
- Understanding business logic and business rules
- Architecture recovery
- Identifying services
- Modernizing the architecture
- Validation

Based on agile principles (IICT-BAS will contribute to this).
EPF implementation

Feasibility analysis

[no]  [yes]

Recovery

Migration

Validation and release

[new feature(s)]

[complete]
Software engineering challenges during migration

- **Feasibility stage**
  - Set of questions to answer
  - Identifying SOA and cloud benefits for the context

- **Modernizing the architecture**
  - Separating business logic from APIs;
  - Separating business logic from data;
  - Changing the synchronous behavior of legacy systems to the asynchronous behavior of services;
  - Componentization of architecture to improve scalability

- **Defining quality characteristics in the cloud: max load, accessibility, etc.**
ESSENSE initiative

- SINTEF is together with the SEMAT initiative following up work on defining a RFP regarding developing a DSL for software engineering.

- This will include support for developing methods based on practices defined in Kernel and any other ones.

- IICT-BAS will join SINTEF in this work.
## Overall view of REMICS research

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<tr>
<th>Warsaw University of Technology</th>
<th>Tech: RSL</th>
<th>Case: Banking</th>
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<tbody>
<tr>
<td>DISYS</td>
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<td>ESL (SHAPE)</td>
<td>Service engineering methodologies</td>
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<td>Knowledge Discovery</td>
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<td>SOFT (SHAPE, RTE Space, WebMov)</td>
<td>Forward MDA</td>
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<td>KDM</td>
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<th>University of Tartu</th>
<th>Tech: OLAP - OLTP</th>
<th>cloud performance</th>
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### REMICS Baseline input
- DISYS: Existing systems
- DOME: Existing systems
- ESL (SHAPE): Service engineering methodologies
- RSL (SHAPE): Knowledge Discovery
- SOFT: (SHAPE, RTE Space, WebMov) Forward MDA
- SINTEF (SHAPE, SWING): MDI, SoaML
- Fraunhofer: (ModelPlex, RTE Space) Model Checking, MBT

### REMICS areas
- Travel Management System
- ERP/Accounting/CRM system
- Methodology

### REMICS Results
- Use cases
  - Migrated systems to Service Clouds
  - New and enhanced systems
- REMICS Methodology
  - REMICS modernization methodology
  - Agile
- REMICS modernization
  - REMICS KDM extensions
  - REMICS Service Clouds patterns and transformations
  - OLAP - OLTP + RSL
- REMICS support
  - REMICS Service Interoperability
  - REMICS Models@Runtime
  - REMICS Model Checking and MBT
  - Enhanced MBT and Cloud performance
- Standard contributions
  - PIM4Clouds
  - BPMN2.0
  - SoaML
  - U2TP
  - KDM extensions

### Active involvement in standards
- +RSL
- +KDM
- +OMG
- +SEMAT
- Agile
- SE
Pilot cases in REMICS

- Two pilot cases in existing project:
  - DI systems from Norway with ERP/accounting
  - DOME consulting from Spain within the tourism section

- Three new pilot cases in the enlarged project:
  - Bank and finance (WUT)
  - Scientific applications (UT)
  - Transport (IICT-BAS)
**Expected impact**

- REMICS will preserve and capitalize on the business value engraved in legacy systems to gain:
  - flexibility brought by Service Clouds,
  - lower the cost of service provision,
  - shorten the time-to-market.

- REMICS research will provide innovations in advanced model driven methodologies, methods and tools in Software as a Service engineering.

- REMICS will provide standards-based foundation service engineering and will provide a suite of open ready-to-use metamodels that lowers barriers for service providers.
REMICS and Standards

- REMICS-KDM Extension
- BPMN
- SBVR
- BMM
- ODM
- RSL

Methodology

- CIM
- PIM
- PSM

REMICS PIM4ServiceClouds

- PIM 4 Cloud
- PIM 4 Service Interoperability
- PIM 4 Models @ Runtime

SoaML

UE ML Profiles for Web Services (XSD, WSDL, BPEL), OGSA and Service Cloud Platforms

RESERVOIR, SUN, Joyant, Amazon, Google, Microsoft, Cordys

Deployment Platforms

UML 2 Test Profile
About us

- SINTEF is a research organization in Norway with over 2000 employees in Oslo and Trondheim.

- Networked Systems and Software is part of ICT with 260 people and has three groups around model-based development, security and HCI.

- Our expertise in:
  - modeling, metamodeling (SoaML, CVL), transformations, traceability, quality in modeling
  - Services and Things
  - Adaptive systems
  - Architecture, interoperability and semantic technologies etc.

- Projects:
  - ATHENA
  - INTEROP
  - IRMOS
  - MoSiS
  - MODELWARE
  - MODELPLEX
  - DiVa
  - COIN
  - EMPOWER
  - SESAR
  - REMICS
  - NEFFICS
  - And national projects

- Several standards and open source tools
Future research in Call 8; interests

- Internet of Things and Internet of Services
  - Adaptive systems at all levels
  - Optimization, testing, run-time management

- Cloud computing
  - Following research in developing solutions to manage the challenges
    - Interoperability
    - Abstraction and modeling
    - Migration strategies and business models
    - Services and platforms
    - Software engineering for the cloud
Thank you and

Questions?

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