Easy Development of Scalable Web Services Based on Model-Driven Process Management

Second OMG Workshop on Web Services Modeling

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Outline

- Introduction to Web Services
- Introduction to Business Process Management
- 4-Tier Web Services Architecture
- The Role of the MOF
- Business Process Modeling
- Web Service Modeling & Generation
- Summary
Characteristics of Web Services

Web Services represent client-server architectures with these distinct features:

- Utilization of the World-Wide-Web infrastructure
- Utilization of Web protocols
- Minimum infrastructure requirements for the client side ("Thin Client")
  - Web browser
  - Web-enabled application
- Required processing mostly concentrated on the server side
Existing Services on the Web

- Are typically hard-coded
  - Scripts or local programming at the web server implements the desired functionality
  - Linkages to back-office applications are fixed
- May use HTML Forms or Java Applets to implement interaction with client users
- May use “Server Pages” technology to create dynamic content
Existing Services on the Web (2)
Existing Services on the Web (3)

This simple architecture has a set of disadvantages and problems:

- Any change requires programming
- Number of back-office services and their locations typically fixed after web server programming has been completed
- Limited growth potential
- Limited scalability
- Security only as good as firewall
Adding a Portal Server (1)
Adding a Portal Server (2)

The addition of a portal server results in improvements compared to the simple architecture:

- Decoupling of web server from applications
- Greater flexibility in application integration
- Support for dynamic web presentation
- More options to handle security
- But still limited scalability
- Still needs programming for any change
Business Process Management (1)

- A technology successor of Workflow Management
- Allows to model sequences of actions, possibly involving a flexible set of multiple applications
- Supports rapid service creation with no or minimal programming
- Provides a high degree of flexibility
Business Process Management (2)

- Process Management allows a high degree of business automation

- Improved security due to controlled processes
Business Process Management (3)

So, now where is the catch?

- Currently there exists a substantial number of (incompatible) standards for business process management
- Previous attempts to unify these standards have failed
- The most promising approach for harmonization is through meta-modeling techniques (as promoted by the OMG)…
- …and supports automation of Web Service development
4-Tier Web Services Architecture

User Tier
- Message Handling
- View Controller
- Presentation

Workspace Tier
- Business Document Processing
- Work Coordinator
- Session
- User Profile

Enterprise Tier
- Composed Business Services
- Business Process
- Business Entity

Resource Tier
- Application Adapter
- Resource Adapter

Source: Mike Rosen, David Frankel
4-Tier Web Services Architecture

User Tier
- Message Handling
- View Controller
  - Presentation

Workspace Tier
- Business Document Processing
- Work Coordinator
  - Session
  - User Profile

WEB SERVICE

Enterprise Tier
- Composed Business Services
  - Business Process

Resource Tier
- Application Adapter
- Resource Adapter

BUSINESS PROCESSING

Source: Mike Rosen, David Frankel
Get Assistance from MDA Technology

User Tier
- Message Handling

Workspace Tier
- Business Document Processing
- Work Coordinator

Enterprise Tier

Resource Tier

Design your Business Process first …
then have the Web Service Aspects generated

Presentation
Session
Profile
The Importance of Metamodels

- The key to the Model Driven Architecture (MDA) technology are not models but metamodels.
- Metamodels represent a formal language for the definition of corresponding models.
- This formal language allows an automated creation and interpretation of models without the need for model-specific programming.
- The Meta Object Facility (MOF) manages a hierarchy of metamodels and models; it is the most important building block in the MDA landscape.
The 4-Level Meta-Architecture

- **M0**: Instance Level
- **M1**: Meta-Data or Model Level
- **M2**: Meta-Meta-Data or Meta-Model Level
- **M3**: Meta-Meta-Meta-Data or Meta-Meta-Model Level
The 4 Business Process Meta Levels

- **M0**: Running Business Process Instances
- **M1**: Your Business Process Definitions
- **M2**: Definition of the BP Modeling Language
- **M3**: The Abstract MOF Language
The 4 Web Services Meta Levels

- M3: The Abstract MOF Language
- M2: Definition of the WS Modeling Language
- M1: Your Web Services Definitions
- M0: Active Web Services Sessions
The MOF Advantage

If we can define **multiple** modeling languages using the **same** abstract MOF language, then we can:

- Use an arbitrary number of modeling languages, if necessary (Provided they are semantically compatible)
- Build model transformations residing in the MOF on M2 level
- Build code generators processing M1 models under control of the corresponding M2 metamodel
- Manage the whole system out of a single modeling facility
Business Process System Evolution

MOF 1.5 / 2.0
Meta-Meta-Model

Process Definition Language
Meta-Model

Process Definitions
Model

Executable Process Instances
Instance

<table>
<thead>
<tr>
<th>Legacy Workflow</th>
<th>BPML</th>
<th>WSFL</th>
<th>EDOC based Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0</td>
<td>M0</td>
<td>M0</td>
<td>M0</td>
</tr>
</tbody>
</table>

MOF 1.5 / 2.0

- Hard coded
- Model defined
Modeling the Business Process (1)

- Modeling of business processes must be on Business Component level, not on Class / Attribute / Operation level
- Plain UML is not favorable, too low level, but:
- Specialized UML Profiles or MOF Metamodels will be very efficient
  - Most promising: UML Profile for Enterprise Distributed Object Computing (EDOC)
- Specialized tools based on these model may provide enhanced functionality and convenience
Modeling the Business Process (2)

- Business components are re-usable building blocks
- Wrapped applications
- Components embedded in a container system
- ...
- Creation of a business component may be a substantial task, but is a one-time effort
EDOC Business Process Notation
Our Simplified Activity Symbol (1)

- Blue arrow: Choreography (~Control Flow)
- Green arrow: Data Flow
- Orange arrow: Event Channel

Name: [Insert Name]
Our Simplified Activity Symbol (2)

- Choreography is single connection only
- Data Flow and Event Channel allow multiple connections
- Input Group and Output Group control pre- and post-conditions to synchronize Activity execution with Data Flow and Event Channel
Our Simplified EDOC Process Notation
Data Flow Details

- multi-data channel
- output group mapping table
- input group mapping table
Web Service Modeling

- Web Services messaging can be expressed as business process interaction
- The same is true for the web presentation
- The graphic aspects of the presentation can be covered by specialized components

- The complete service can be modeled in the MOF
- The MOF can feed models into translators to web languages (like WSDL), controlled from M2 level
State of the Art and Standardization

- UML Profile for EDOC is an adopted OMG specification; several implementations exist
- EDOC-based process modeling and management systems exist
- A unifying business process metamodel is in development
- MOF is a formal OMG specification; several implementations exist
- Formal MOF-based model transformations is in development
- EDOC to WSDL mapping is in development
Summary

- Metamodels and the MOF play an important role in the automated generation and operation of web services
- Individual web service functions can be modeled as business processes (based on EDOC)
- Graphic aspects of a web service will be represented as business components attached to the business process
- All web service description, messages and presentation can be generated from the MOF representation
Thank you ...

Questions?

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