Identifying and Specifying Reusable Services of Service Centric Systems through Product Line Technology

Position Paper

Dr. Jaejoon Lee
jaejoon.lee@iese.fraunhofer.de

Outline

• Introduction
• Approach Overview
• Service Identification
• Service Specification
• Summary
• "Service-oriented architecture (SOA)" is an emerging concept for the development of information systems
  - Not for a statically configured system
  - Service providers/consumers may join in and leave from a system dynamically (i.e., at run time)
  - Some examples include Web services, ebXML, etc.

• One of the challenges for the development of SOA based systems is the dynamic management of services such as:
  - Deployment of a new service
  - Modification of current service behaviors
  - Removal of an unavailable service
  - Management of available resources

Some challenges for developing service oriented systems in product line engineering
• While taking advantages of “service-orientation” (e.g., scalability), variations of a product line should be also managed.
  - Selection and customization of service features with or without users’ interventions
    - Operating context relevant services should be provided.
  - Provision of dynamic adaptivity
    - Depending on available resources at a certain situation, available service features and their quality may vary.
  - Management of change impacts from dynamic addition / modification / removal of service features
    - Incorrect coordination of services features after product reconfiguration may result in system failure.
Application Domain – “Virtual Office of the Future”

- General definition: virtual office
  - A type of telecommute in which workers are equipped with the tools, technology and skills to perform their jobs from anywhere the person has to be – home, office or customer’s location. ([Wikipedia])
- Research areas
  - Document management (i.e., efficient management of heterogeneous document types)
  - Workflow modeling (i.e., capturing and optimizing office workflows)
  - Workflow management (i.e., tool support for workflow artifacts)
- (Product Line) Software Engineering Methods
  - Efficient generation of solutions supporting diverse organizations, roles, and infrastructures
  - Ensure system dependability
    - Anywhere => Focus Adaptivity,
    - Anytime => Focus Availability

Activities of the approach

Legend: Name Activity
- Feature and feature binding analyses
  - Feature model
  - Feature binding units
  - Feature binding time
- Service analysis
- Orchestrating services
  - Orchestrating service specifications / development
- Workforce control components
- Molecular service specifications / development
- Reusable service components
- System integration and deployment
- A target system
- Retrieved services
- Reusable service repository
Key Concepts

- Molecular Service (MS) Identification as for a Unit of Orchestration
  - Self-contained (control + computation)
  - Stateless from service user's point of view
  - Taxonomies for services (ontology information; domain-specific)
  - Pre/post conditions and invariants for each MS

- Quality of service for each MS
  - Quality attributes in terms of features
  - Contextual information to determine one of the attributes (who makes the decision? what factors affect the decision?)

- Workflow based Service Behavior Specification
  - Dependable orchestration of molecular services
  - Pre/post conditions and invariants for each workflow
  - Connection to operational context for the selection of QoS attributes at run time

Molecular Service Identification

Orchestrating Service Layer

Molecular Service Layer

Legend:
- Optional
- Alternative
- Composed-of relationship
- Generalization relationship
- Molecular Service
- Parameters of Molecular Service
- UML

Copyright © Fraunhofer IESE 2007
Workflow Specification: Dependable Orchestration of Molecular Services

Example of Business Trip Planner

workflow BUSINESS TRIP Planner (trip:Trip, t:Traveler, c:Country Name)
Inv LIESE_Employee == True & trip.validity ≠ Canceled
pre t.authetification == Logged_in
post trip.postmortemReport == Submitted

Molecular services to be triggered for this task
- Retrieve information of visiting places (weather, currency, security, etc)
- Check items to carry
- ...

Local task support
- Retrieve hotel information
- Retrieve most relevant transportations
- Print itinerary at a nearest printer to the traveler
- ...

Legend
- Local work flow
- Global work flow
- Name
- Locality of a task
Addressing Integrity - Molecular Services Specification

**Legend**
- r: root
- m: mandatory
- o: optional

--- Static binding relation
--- Dynamic binding relation

```
**molecular service** FOLLOW ME (user User)
invariant user.IESE_Employee == true
precondition user.authentification == logged_in
postcondition none;
option Environment Visualization
  binding time run time
  precondition user.device == desktop ∨ notebook
  postcondition none;
option Automatic Log-on
  binding time run time
  precondition user.rank == director ∨ manager and
  RFID bases user location method == available
  postcondition user.access == granted ∨ rejected;
```

```
**molecular service** ALLOCATE DEVICE (user User)
inv user.IESE_Employee == true
pre user.authentification == logged_in
post user.device_allocation == success ∨ failure
option Attribute Based Device Allocation
  binding time installation time
  precondition user.rank == director ∨ manager
  postcondition none;
```

```
**molecular service** NOTIFY (sender User, receiver User)
inv sender.IESE_Employee == true
pre sender.authentification == logged_in
receiver.email ≠ null
postcondition none;
option SMS
  binding time run time
  precondition sender.cell_phone_number ≠ null and
  sender.message != null and
  receiver.cell_phone_number ≠ null
  postcondition sender.message == null
```

**Behavioral View - Dynamic Reconfiguration of Workflow Bricks**

Statechart Template for a Workflow Brick

- Start Service
- In-Service
  - Initialization
  - Normal
  - Suspend
  - Suspending
  - Resume
  - Reconfiguring
  - Reconfigure
- Termination
  - Terminate service
  - Suspending
  - Reconfiguring

- Brick is running
- Brick is suspended
- Brick is stopped
Summary

- Feature based identification of molecular services and their quality attributes
- Extension of workflow specifications with pre/post conditions and invariants for dependable service orchestration
- Architectural framework for the systematic integration of multidisciplinary design paradigms: dependability, adaptivity (dynamic variations), and service orientation
- Prototype development to demonstrate the feasibility of proposed approach