GiSHEO
Service Composition

Denisa Rodilă, Victor Băcu, Dorian Gorgan, Teodor Ștefănuț,
Computer Science Department
Technical University of Cluj-Napoca
{denisa.rodila, victor.bacu, dorian.gorgan, teodor.stefanut}@cs.utcluj.ro
Outline

- Concepts
- Approach
- Architecture
- Service Composition Flow
- Business Workflow
- Results
- Conclusion
Concepts

- **gProcess** - application designed as a tool for description, scheduling and execution of satellite image processing workflows over the Grid

- **PDG** – (Process Description Graph) abstract description of processes having as operands satellite images and as operators simple operations

- **IPDG** – (Instance of Process Description Graph) instantiation of a PDG with physical resources – specific satellite images

- **Business workflow** – abstract description of a logical composition of one or more Web services

- **Business process** – instantiation of a business workflow by mapping physical end-point – actual Web services – to the workflow
gProcess workflow - example

Band 1
Band 5
Band 3
Band 4
Multiply
Add
Not
Add
Sub
Business Workflow

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Approach

- Composition of Web services in two major phases:
  - Automatically searching the Web services
    - UDDI private repository
    - Semantic annotation
  - Automatically binding the information of selected Web services to predefined templates used for BPEL business process creation and instantiation
Approach

- Automatic discovery of Web services
- Automatic binding of Web services
- Semantic annotation
- Composition of Web services based on templates
- Automatic invocation of composed Web services from a Grid environment
Approach

- In the gProcess application the Web service are used for integrating operators as composed Web services in a satellite image processing workflow
Approach

- Advantage: gProcess can be used in a Grid environment for creating computation nodes such as
  - Operators
  - Sub-graphs
  - Web services
Service Composition - Architecture
Architecture - Modules

- Service Registry
- Service Discovery
- Workflow Composition
- Workflow Instantiation
- Business Workflow Engine
- Client
Service Registry

- UDDI registry - Web service discovery technology
- Provides discovery mechanisms based on simple string matching of service descriptions and classifications of service instances
- Offers support for selecting the service providers using authentication
Business Workflow Engine

- The Business Workflow Engine must:
  - support hot deployment of workflow definitions – deploy new workflow processes, change existing workflow processes and delete obsolete ones without having to restart the engine
  - Support easy integration with Grid environment and Grid services for future developments
Implementation

- Used technologies:
  - BPEL language
  - ActiveBpel workflow engine
  - JUDDI – Java library for UDDI Web service registry
  - Ontolink – semantic annotation tool for simple Web services
  - MySQL database
  - SWI-Prolog – prolog library used for semantic annotation based search
  - JPL – Java library for prolog integration
Service Discovery

1. Searching in UDDI
   o First level of search
   o Reduce the searching set of Web services
   o Use appropriate queries to interrogate the UDDI registry based on service category and service name
Service Discovery

2. Semantic annotation
   - Second level of search
   - Apply semantic annotation on the result set of Web services obtained from the first level
   - Perform prolog queries for matching services based on inputs and outputs number and their types
Service Discovery

1. String matching search in UDDI
2. Add semantic annotation on resulting set
3. Semantic search on Service semantic annotation
Workflow Composition

- XML based template files required for BPEL process
  - Process WSDL
  - Process definition file (BPEL)
  - Web service WSDL definition
  - Process Deployment Descriptor (PDD)
  - WSDL Catalog
Workflow Instantiation

- Java classes to map the BPEL entities
- Java classes for processing and instantiate the templates
Client

- Realizes the connection with gProcess
- Dynamically invokes the composed Web Service
  - Generate stub classes based on process WSDL using ws-import
  - Instantiate necessary classes for process invocation using Java reflection
<Workflow>
  <Nodes>
    <Resource>..
    </Resource>
    <Operator>
    </Operator>
    <Subgraph>
    </Subgraph>
    <Subgraph>
    <Service>
    </Service>
    </Service>
  </Nodes>
  <Groups>
  </Groups>
</Workflow>

New PDG Structure
gProcess Integration - Example

Add

Subgraph1

Service

romania2_B1.tif

romania2_B2.tif

romania2_B3.tif

romania2_B4.tif

romania2_B5.tif

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Service Composition Flow

1. Add satellite image operator to gProcess workflow

2. Exists Composed Web service

2.1 YES

2.2 NO

2.2.1 Search for Web service in UDDI

2.2.2 Add semantic annotation for the UDDI result set

2.2.3 Perform semantic based search

2.2.4 Bind the founded Web service to abstract workflow

2.2.5 Create and deploy business process

3. Invoke composed Web service
gProcess Main Flow

1. Parse the IPDG
2. Expand the Sub-graphs
3. Find Operations order
4. Generate Execution nodes for local operators
5. Submit the nodes as Condor jobs on Grid
6. Obtain result

- **Create Service nodes for service operators**
- **Publish Web Service to UDDI**
- **Search for Web service in UDDI**
- **Add semantic annotation for the UDDI result set**
- **Perform semantic based search**
- **Bind the founded Web service to abstract workflow**
- **Create and deploy business process**

- **Invoke composed Web service**

- **Exists Composed Web service**
  - **YES**
  - **Invoke composed Web service**
  - **Create and deploy business process**
  - **Stop**
  - **NO**
  - **Search for Web service in UDDI**
  - **Add semantic annotation for the UDDI result set**
  - **Perform semantic based search**
  - **Bind the founded Web service to abstract workflow**
  - **Create and deploy business process**
  - **Stop**

Start Stop
Business Workflow Deployment

- Instantiate PDD file
- Update Services WSDL file
- Instantiate PDD file
- Instantiate WSDL Catalog file

Create BPR archive

Deploy

ActiveBPEL engine
Results

- Web service discovery based on the required parameters
- Workflow instantiation: correct mapping between Web service and existing template files and successfully deployed business processes
- Invocation of the composed Web service using the generated stub classes
- Results obtained from the composed Web service for given input data
- Integration of gProcess workflows with the composed Web service
Conclusions

- Automatic discovery of Web services
- Automatic binding of Web services
- Semantic annotation
- Composition of Web services based on templates
- Automatic invocation of composed Web services from a Grid environment
Questions?

Thank You!

Denisa Rodilă, Victor Bacu
Computer Science Department
Technical University of Cluj–Napoca
{denisa.rodila,victor.bacu}@cs.utcluj.ro