Web Services
Annotation and Reasoning

Mikhail Roshchin, PhD Student
Peter Graubmann, Evelyn Pfeuffer
CT SE 2, Siemens AG
roshchin@gmail.com
Motivation _ Current Problems

• Software Applications
  • work with and
  • depend on
  a concrete _SYNTACTIC_ representation of the information

• To acquire information from different sources and domains is a difficult task

• Web service standard specifications do not support dynamic composition

• Until now, “semantic” description approaches do not cover full business life-cycle
Motivation _ Expectations

• Service provider requirements:
  • Clear and easy way to describe services
  • Advanced possibilities to define and distinguish requirements, properties, characteristics, guaranties, …
  • Flexibility – applicability of own terminology and its structure
  • Means to describe dynamic qualities due to business process modeling
  • Advanced features for providing variability in semantic descriptions
  • Consistent information

• Service requestor requirements:
  • Replace simple keyword search by a “semantic” one
  • Facile way to describe requirements, post- and pre-conditions
  • Possibility to formally express desired scenarios, business processes, workflows
  • Mechanisms for translating automatically visual specifications (UML, MSC) into formal ones
  • Formal specifications should be very intuitive, flexible, and close to natural language expressions
Current Work _ Framework Conception

• Goal:

Elaboration of a framework to support comprehensive semantic descriptions of Web services and their lifecycle

• Main features:

- flexible way to semantically annotate Web services based on the diversity of ready solutions, models, patterns specified for concrete domains, situations and user groups;
- integrating the connector concept for the service behavior description;
- uses the conception of “Logic-on-Demand”, which provides a variety of formal semantic specifications based on different logical formalisms with different levels of expressivity and decidability;
- provides an intuitive interface to work with logical reasoners;
- the conception is based on a Service Description Reference Model;
- user-friendly way to provide hybrid solutions for different user groups and their needs.
Current Work _ The Connector Conception

- **Peter Graubmann:** *Describing interactions between MSC Components: the MSC Connectors*, *Computer Networks* 42, 2003.

Current Work _ “Logic-on-Demand” Conception

“Logic-on-Demand” – hybrid solutions for expressing semantic knowledge in WS on different levels of user roles and requirements:

• Terminological representation and reasoning (Description Logics)
• Rule-based representation and reasoning (extensions of DL, FLORA, FOL)
• Temporal representation and reasoning (Modal Logics)
• Uncertain knowledge and probability representation and reasoning (Fuzzy Logics)
Idea _ How “Logic-on-Demand” Should Work

Semantic Description

Applications / Users / etc.

Logic Programming

XML Programming

- Racer
- FLORA
- Prolog
- DL
- F-Logic
- FOL
- OWL
- RDF
- XML
- OWL Parser
- RDF Parser
- XML Parser

Logic Programming

XML Programming

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Idea _ Dynamic Annotation

Dynamic Annotation
(Terminology, Structure, Formulas, Probability Functions etc. for concrete service)

- Probability, Temporal, Modal, Fuzzy Logic Specifications
- RuleML, F-Logics, First Order Logic Specifications
- Description Logic Specification (OWL)

Annotation
(Concrete values for different characteristics)

- Description Logic Specification (OWL)
Idea _ Cooperation

Environment
- Network Infrastructure
- Geographical Location
- CPU
- Quality of Sources
- Databases
- ...

Web Service Dynamic Annotation
- Functional Properties
- Non-functional Properties
- Pre- & Post-conditions
- ...

Web Service Annotation
- Functional Properties
- Non-functional Properties
- Pre- & Post-conditions
- ...

Customer
- Business Scenario
- Functional Requirements
- Non-functional Requirements
- ...

Mapping Mechanisms

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Idea _ The Key Points

• To introduce relevant formal language specifications for describing semantic information of Web services and software components
• To support semantic description for the complete life-cycle
• To introduce understandable and processable semantics: Ontologies, Ontology Languages, Ontology merging and alignment, Ontology Reasoning
• To provide the proper way for automation of composition, mediation, compensation, execution of software components and Web services
• To introduce variability and probability features into the semantic description process (diversity of user groups, business scenarios, environment)
• To distinguish different levels of semantic formalisms and define relevant formal logical specifications for them
Big Picture _ Service Description Reference Model

Service Description Reference Model (SDRM)
- General Ontologies
- Company-specific Ontologies
- Specific Ontologies for Semantics Micro-Models

Ontology
- Logic & Inference

Logic & Inference Engine
- Inference Engine
- Logic

Semantics Micro-Model
- Semantics Model
- Semantics Micro-Model
- Semantics Micro-Model

External Service Description Models
- General Ontologies
- Domain Specific Ontologies
- Semantics Models
- Used Logics

Company External Servers / Clients
- Annotation
  - Service Property Description
- Annotation
  - Client Requirements Description

Company Internal Servers / Clients
- Annotation
  - Service Property Description
- Annotation
  - Client Requirements Description

Matchmaking between external Annotations: Mapping onto the SDRM

Matchmaking between internal Annotations: Based upon the given Templates that directly correspond to the SDRM

Template for Semantic Service Description

Framework

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Use Case _ Dynamic Annotation

- PRICE
- Number of Sources
- List of Sources
- Response Time

Response Time depends on:
- Number of Sources
- List of Sources
- Response Time

Dynamic Annotation:
- Number of Sources = 25
- Price = 10 €
- Fidelity = 65%
- Response Time = 4 ms

Rule-based Level (F-Logic, FOL, RuleML)

Probability Level (Modal, Temporal, Fuzzy Logics)

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Perspectives _ What to Do

• Elaboration on the concepts

• Validation on a concrete project
  • Definition of SMMs …

• Research in presentation of temporal, probabilistic and uncertain knowledge in Web services