Web Service Modeling Ontology (WSMO) - An Ontology for Semantic Web Services

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(On behalf of the WSMO Working Group)

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• WSMO overview
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WSMO Working Groups

A Conceptual Model for SWS

A Formal Language for WSMO
A Rule-based Language for SWS

Execution Environment for WSMO

WSMO Working Group
Underlying Principles

- Web Compliance
- Ontology based
- Strict decoupling
- Centrality of mediation
- Ontological role separation
- Description vs Implementation
- Execution Semantics
- Service vs Web Service
WSMO Top Level Notions

Objectives that a client wants to achieve by using Web Services

Provide the formally specified terminology of the information used by all other components

Semantic description of Web Services:
- **Capability** *(functional)*
- **Interfaces** *(usage)*

Connectors between components with mediation facilities for handling heterogeneities
Non-Functional Properties

- Dublin Core Metadata Set:
  - complete item description
  - used for resource management
- Quality of Service Information
  - availability, stability
- Other
  - Versioning, Owner, financial
## Non-Functional Properties List

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WSMO Top Level Notions

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Ontology Specification

- **Non functional properties** (see before)
- **Imported Ontologies** importing existing ontologies where no heterogeneities arise
- **Used mediators** OO Mediators (ontology import with terminology mismatch handling)

**Ontology Elements:**

- **Concepts** set of concepts that belong to the ontology, incl.
- **Attributes** set of attributes that belong to a concept
- **Relations** define interrelations between several concepts
- **Functions** special type of relation (unary range = return value)
- **Instances** set of instances that belong to the represented ontology
- **Axioms** axiomatic expressions in ontology (logical statement)
WSMO Top Level Notions

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Connectors between components with mediation facilities for handling heterogeneities
WSMO Web Service Description

- complete item description
- quality aspects
- Web Service Management

Non-functional Properties

DC + QoS + Version + financial

Capability

functional description

- Advertising of Web Service
- Support for WS Discovery

Web Service Implementation

(not of interest in Web Service Description)

client-service interaction interface for consuming WS
- External Visible Behavior
- Communication Structure
- ‘Grounding’

realization of functionality by aggregating other Web Services
- functional decomposition
- WS composition

Choreography --- Service Interfaces --- Orchestration

WSMO Working Group
Capability Specification

- Non functional properties
- Imported Ontologies
- Used mediators
  - **OO Mediator**: importing ontologies with mismatch resolution
  - **WG Mediator**: link to a Goal wherefore service is not usable a priori
- Pre-conditions
  What a web service expects in order to be able to provide its service. They define conditions over the input.
- Assumptions
  Conditions on the state of the world that has to hold before the Web Service can be executed
- Post-conditions
  describes the result of the Web Service in relation to the input, and conditions on it
- Effects
  Conditions on the state of the world that hold after execution of the Web Service (i.e. changes in the state of the world)
Choreography & Orchestration

• **VTA example:**

  - **Choreography** = how to interact with the service to consume its functionality
  - **Orchestration** = how service functionality is achieved by aggregating other Web Services
Service Interface Description Model

- **Vocabulary** $\Omega$:
  - ontology schema(s) used in service interface description
  - usage for information interchange: in, out, shared, controlled

- **States** $_{\_\text{\_\_\_}}$:
  - a stable status in the information space
  - defined by attribute values of ontology instances

- **Guarded Transition** $\text{GT}(\_)$:
  - state transition
  - general structure: _if_ (condition) _then_ (action)
  - different for Choreography and Orchestration
Objectives that a client wants to achieve by using Web Services

- Capability (functional)
- Interfaces (usage)

Connectors between components with mediation facilities for handling heterogeneities

Provide the formally specified terminology of the information used by all other components

Semantic description of Web Services:
Goals

- Ontological De-coupling of Requester and Provider
- Derived from task / problem solving methods/domain model
- Structure and reuse of requests
  - Search
  - Diagnose
  - Classify
  - Personalise
  - Book a holiday
- Requests may in principle not be satisfiable
- Ontological relationships & mediators used to link goals to web services
Goal Specification

- Non functional properties
- Imported Ontologies
- Used mediators
  - *OO Mediators*: importing ontologies with heterogeneity resolution
  - *GG Mediator*:
    - Goal definition by reusing an already existing goal
    - allows definition of **Goal Ontologies**
- Requested Capability
  - describes service functionality expected to resolve the objective
  - defined as capability description from the requester perspective
- Requested Interface
  - describes communication behaviour supported by the requester for consuming a Web Service (Choreography)
  - Restrictions / preferences on orchestrations of acceptable Web Services
Objectives that a client wants to achieve by using Web Services

- Provide the formally specified terminology of the information used by all other components
- Semantic description of Web Services:
  - Capability (functional)
  - Interfaces (usage)

Connectors between components with mediation facilities for handling heterogeneities
Mediation

- **Heterogeneity …**
  - For 1$ on programming, $5 - $9 on integration
  - Mismatches on structural / semantic / conceptual / level
  - Assume (nearly) always necessary

- **Description of role**
  - Components that resolve mismatches
  - Declarative description of arbitrary web service

- **Types of Mediation within Semantic Web Services (WSMF):**
  1. **Data:** mediate heterogeneous Data Sources
  2. **Protocol:** mediate heterogeneous Communication Patterns
  3. **Process:** mediate heterogeneous Business Processes
WSMO Mediators Overview
Mediator Structure

WSMO Mediator
uses a Mediation Service via
- as a Goal
- directly
- optionally incl. Mediation

Source Component

Source Component

1..n

Target Component

Mediation Services
Relationship to standards

- **Web Service**
  - Choreography in web services
    "the interactions of services with their users. Any user of a Web service, automated or otherwise, is a client of that service. These users may, in turn, be other Web Services, applications or human beings."
    - WSDL
    - WS-CDL

- **Semantic Web**
  - RDF
  - OWL
Variants of WSML

WSML space

WSML-Flight

WSML-Core

RDFS

WSML-OWL

DL

Lite

Full

OWL-DL

WSML-Full

WSML-Rule

WRL
Use Cases

- WSMO use cases
- WSMX use cases
- 3 within DIP
  - eGovernment
  - B2B Integration in Telecoms
  - eBanking
- Other EU projects
  - Cocoon project
  - ASG
  - KnowledgeWeb
European Train Travel Demo
WSMO Summary

- Web compliant
- Represented in WSML family
- Goal
  - User as (ontological & distinct) “First class citizen”
- Web Service
  - Capability
  - Interface
    - Choreography
    - Orchestration
- Mediator
  - Source, target, mediation service
  - Brought to fore because of importance
http://www.wsmo.org