Service Oriented Architecture (SOA)

Michael Herrmann

Applying Semantics within SOA
Agenda

- Common understanding
  - Definitions (selection) & Background
  - Big Picture
  - Services within SOA
  - Enterprise Service Bus (ESB)
- EMEO
  - Scenario I
  - Scenario II
  - WSDL-S
  - Symbolic + Inference
- Summary
“Introducing” my working area
Definition

„SOA is a technology neutral concept of Software architecture that represents one or more business functions as a service.

The interface description of a service is platform independent.

The implementations of the services are reusable, encapsulated and loosely coupled.

The service interactions are realized by a standardized/uniformed infrastructure.”

[DaimlerChrysler EMEA]
SOA Big Picture

Modeled Business Process

Level 0 (VCD)

Level 1-4 (eEPC)

Process/Workflow Engine

Enterprise Service Bus (ESB)

SAP

IBM

.NET

Host

Enterprise Business Layer

Platform specific Business Layer

Presentation Layer

Infrastructure Layer

Registry

Repository

DB

SAP Applikation

J2EE/PAI Applikation

.NET Applikation

Host Applikation

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Services inside SOA

<table>
<thead>
<tr>
<th>Operations</th>
<th>Inputs</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>OP₁</td>
<td>IN₁</td>
<td>OUT₁</td>
</tr>
<tr>
<td>OP₂</td>
<td>IN₂</td>
<td>OUT₂</td>
</tr>
<tr>
<td>OP₃</td>
<td>IN₃</td>
<td>OUT₃</td>
</tr>
</tbody>
</table>

Service Caller

Service
Service within SOA

- A Service
  - is a unit of third party composition
  - has no (externally) observable state (encapsulates its state)
  - is described platform independent (Interface)
  - is potentially already deployed (deploy once, reuse several times)
  - is Black Box reuse

- Business Service is a Service
  - representing one or more Business functions
Enterprise Service Bus (ESB)

- Transport and content-based routing (Brokerage: Publish-Subscribe)
- Multi-protocol communication
- Validation and transformation (messages)
- Supports
  - Event-handling
  - Security (Partial Security on the message layer)
  - Monitoring
  - Adapter-connectivity
  - Dynamic addressing and service binding (Registry)
- Mediation
SOA & ESB & Semantics?!

...reuse is depended upon the strengths of semantics...
Semantics with SOA (Approaches)

- SAWSDL (Semantic Annotations for Web Services Description Language Working Group)
- WSDL-S (Web Service Semantics)
- OWL-S (OWL-based Web Service Ontology)
- WSMO (Web Service Modeling Ontology)
- AI Planning
- Semantic Discovery Service (SDS)
- ...

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EMEO supports loose coupling

EMEO-Layer

OWL

WSDL-S

Mediation

WSDL
Lab based study „440-020“ (IOPE)

MAS+

Trigger Calculate Start-Date

Start-Date is available

input:
(Code Number (SNR), Amount, Delivery-Date)

output: Start-Date
Scenario I

Design-Time

Run-Time

Knowledge

Service Provider 1

Service Provider 2

WID

Deploy

Process Server

MAS+

Assembly

Job

Control

ESB

SOAP / HTTP

SOAP / JMS

BZM

Model of

Operation

hours

WSDL_MAS_PLUS

WSDL_BZM

Deploy

Lookup

Publish

IP address

Port
Scenario II (including EMEO)

Design-Time

- WID
- Interface-Map
- Reasoner
- Ontology

Run-Time

- Process Server
- ESB
- Lookup
- Deploy
- SOAP/HTTP
- SOAP/JMS
- WSDL_MAS_PLUS
- WSDL_BZM
- Service Provider 1
- Service Provider 2

Inference

- Now() > 10am or Now() <= 10am
- Availability (repair work)
- Traffic

MAS+

ontobly

Control

BZM

Model of Operation hours

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WSDL within EMEO

```xml
<definitions>
  <types> ... </types>

  <message>
    <part>... </part>
  </message>

  <portType>
    <operation>
      <input>... </input>
      <output>... </output>
      <fault>... </fault>
      <documentation>... </documentation>
    </operation>
  </portType>

  <binding>
    <operation>
      <input>... </input>
      <output>... </output>
      <fault>... </fault>
    </operation>
  </binding>

  <service>
    <port>... </port>
  </service>
</definitions>
```

abstract description

concrete description
WSDL-S within EMEO
Connecting WSDL to OWL over WSDL-S

- Top Level
  - XML Schema
    - complexType
    - simpleType

- Bottom Level
  - operations (modelReference)
  - references / uses

- XSL
  - schemaMapping
  - modelReference

- OWL
  - effect, precondition, category
Connecting WSDL to OWL over WSDL-S (exemplary)

XML Schema / WSDL

```xml
<xsd:complexType name="...Response">
  <xsd:sequence>
    <xsd:... name="3NR" />
    <xsd:... name="amount" />
    <xsd:... name="date_of_delivery"/>
    <xsd:... name="plausible" />
  </xsd:sequence>
</xsd:complexType>
```

WSDL

```xml
<operation name="CheckPlausi">
  <soap:operation soapAction="..."/>
  ...
</operation>
```

WSDL-S

```xml
<modelReference>
  <schemaMapping>
    <Category>
      <precondition>
        <effect>
        ...
      </precondition>
    </Category>
  </schemaMapping>
</modelReference>
```

OWL

```
owl:Thing
  Concept A
  Concept B
    Concept A.1
    Concept A.2
    Concept B.1
    Concept B.2
```

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WSDL-S @ DaimlerChrysler (Lab Approach)

```xml
<complexType name="CheckPlausiResponse">
  <sequence>
    <element name="SNR" nillable="false" type="dcx:SNR" />
  </sequence>
  <element name="amount" nillable="false" type="xsd:integer"
    wssem:modelReference="AutomotiveDCX#Amount"/>
  <element name="date of delivery" nillable="false" type="xsd:date"
    wssem:modelReference="AutomotiveDCX#Date_of_Delivery"/>
</complexType>

<owl:Class rdf:ID="Amount">
  <owl:equivalentClass>
    <owl:Class>
      <owl:intersectionOf rdf:parseType="Collection">
        <owl:Class>
        </owl:Class>
        <owl:Class>
        </owl:Class>
      </owl:intersectionOf>
    </owl:Class>
  </owl:equivalentClass>
  <rdfs:subClassOf rdf:resource="#Cars"/>
</owl:Class>

<owl:Class rdf:ID="SNR">
  <owl:equivalentClass>
    <owl:Class>
    </owl:Class>
    <owl:Class>
    </owl:Class>
  </owl:equivalentClass>
  <rdfs:subClassOf rdf:resource="#Cars"/>
</owl:Class>
```

---

Schema

OWL Ontology
Splitting our Domain into Areas

DaimlerChrysler

Automotive

Axioms
Symbol stuff (extract)

\[
\text{DoorWayValueParitition} \equiv one \cup two \cup three \cup four \cup five \tag{5.9} \\
\text{one } \subseteq \neg two \cap \neg three \cap \neg four \cap \neg five \tag{5.10} \\
\text{two } \subseteq \neg three \cap \neg four \cap \neg five \tag{5.11} \\
\text{three } \subseteq \neg four \cap \neg five \tag{5.12} \\
\text{four } \subseteq \neg five \tag{5.13}
\]

\[
\text{DCXCar} \equiv \exists \text{hasSeat} (\text{one } \cup \text{two } \cup \text{three } \cup \text{four } \cup \text{five}) \tag{5.41} \\
\text{DCXEngine} \equiv \exists \text{machtesTo.DCXCar} \tag{5.42} \\
\text{DCXEngine} \equiv \forall \text{isAssembledIn.DCXCar} \tag{5.43} \\
\text{...} \tag{5.44}
\]
Inference (Protégé + RACER)
Protégé (OWL Viz)
Summary

- SOA is not JABOWS (“Just A Bunch of Web Services”)
- The Enterprise Service Bus (ESB) is not magic
- Semantics become more important in future
- Results are based on Lab
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