Service-Oriented Architecture and Software Engineering

T-86.5165
Seminar on Enterprise Information Systems (2007)
14.3.2007

Service Discovery

- Development Time
Service Discovery

- Runtime By Name

Service Discovery

- Runtime By Properties
Service Discovery

- Runtime based on reflection
Service-Oriented Architecture and Software Engineering

T-86.5165
Seminar on Enterprise Information Systems (2007)
14.3.2007

"The Bigger Picture"

- SOA in context of the enterprise
- Business Architecture
  - Strategy, Governance, Organization
  - Business Processes
    - "Business Fit"
- Service-Oriented Management
  - Service Execution Management
  - Service Level Management
  - QoS
Business Process Management

- Business Process Management is a systematic approach to improving an organization's business processes
  - Process: a set of coordinated tasks and activities, conducted by both people and equipment, that will lead to accomplishing a specific goal.
  - Grew out of Business Process Re-engineering movement of ’90s (Hammer and Champy 1993).
  - BPM is a general management topic, which focuses on the strategic and operational aspects of process orientation on given area.
  - Increasing number of organizations are looking at BPM as a way to improve efficiency and productivity.
  - BPM tools (or BPMS – Business Process Management Systems) provides technical platform for modeling, analyzing, executing, monitoring and managing business processes.

BPM(S) Overview

- Modeling and Languages
  - A number of competing modeling styles and languages.
  - ~ diagram to model the flow of events/data and activities

- BPM Architecture
  - Tools for designing, modeling and analyzing processes
  - Process manager and execution engine
  - Process libraries (definitions and instances)
  - Connecting middleware (service realization layer)
  - Business Activity Monitoring and Management (runtime)
BPM Vision and Promise

The Vision and Promise:

- A successful BPM solution will take existing processes, streamline them to meet business goals and ultimately impact the bottom and top lines in a positive way.

- Bridge “the gap” between business and IT → better IT – business alignment

But be aware ...

- One BPM or many BPM’s – who owns and controls all this? → Single product / standard approaches have rarely worked in IT.

- The nature of current BPM is “production-oriented”
  - Decomposition is done from the point of view of particular chain of processes and on the flow of work (lacks commonality).
  - Process ownership vs. networked service economy
  - Emphasis on internal process efficiency
  - Input and Outputs are given
  - Processes are designed to be repeatable, but in service economy creativity, change, collaboration and exploration are in key roles

→ Some mismatch with the principles of “service-orientation”
BPM and SOA

- BPM and SOA visions are a good fit
  - BPM: the context of process-control, execution and measurement.
  - SOA: the enabling infrastructure for process-orientation.
  - \(1 + 1 > 2\)

BPM: Process modeling, analysis, simulation

SOA: Orchestrates business processes and mediates providers

Performance monitoring, improvement analysis

Service changes do not impact processes
Process changes reuse services as needed

BA, BPM and SOA

Domain Models

Service Information Model

Interface Dependencies

Business Process Models

Service Dependency Model
BPM and Process-Enabled SOA

- One goal of SOA is to develop an architecture that clearly separates core business layers and process control logic.

- Core business logic
  - Data access, complex calculations and business rules
  - Single Service; coarse-grained, loosely coupled, ACID

- Process control logic
  - Dynamic, with complex coordination of activities and participants
  - Stateful, long-lived transactions
BPM and Process-Enabled SOA

- Process granularity ~ service granularity
  - To what level of detail the process is modeled?
  - "Processes can be subdivided into smaller and smaller units ... An activity is the smallest subprocess that a given process team decides to illustrate on their process diagrams" (Harmon, 2003)
  - Elementary Process: a process that is triggered by a single business event and that does not require further events to occur in order to complete an execution. The work of an elementary process is performed by one organization unit in one location, continuously until the work is done.
  - Business activity represent one candidate service but it is still critical to ensure whether the necessary logic and data can be encapsulated in a service-oriented way or if some service-oriented process redesign is needed.

Questions ?
Service-Oriented Architecture and Software Engineering

T-86.5165
Seminar on Enterprise Information Systems (2007)
14.3.2007

SOA and Web Services

- Web Services offers an open standards-based framework for implementing service-oriented architecture
- Web Services are able to exchange structured documents that contain different amounts of information, as well as information about that information, known as metadata
- In other words, Web Services can be coarse grained, which is one of the most important features of SOA’s
- SOA is not limited to the usage of Web Services, they are still the most important technology for implementing it.
SOA and Web Services

- Most current SOA implementations and ongoing projects are based on Web Services technology
- 1st. Generation Web Services:
  - SOAP – Simple Object Access Protocol
  - WSDL – Web Service Description Language
  - UDDI – Universal Description Discovery and Integration
- WSDL and SOAP are core technologies for building communication framework for SOA

The Evolution of Web Services

- World Wide Web
  - Open, Distributed, Addressable, Accessible

- Emerging Standards and Business Models
  - Universal markup and data presentation – XML, SOAP, ...

- Web Services
  - Business integration, B2B, B2E, "bottom line"

- Process Transactions
  - Web-enablement, eCommerce, B2C, "revenue"

- Publish Info
  - Web Sites, Web Content, Web Presence, "eyeballs"

- Transactional Business Web
  - Dynamic network of services, Transformation, ...

© 2007 Kari Hiekkanen
The Evolution of Web Services

“Standards” vs. “Specifications” vs. “Extensions”

- There are currently dozens of WS-* initiatives, driven by different vendors, organizations and interest groups
- “Standard” = an accepted industry standard
- “Specification” = a proposed or accepted standard
- “Extension” = typically represents WS-* spec or feature

Key Players

- W3C (XML, SOAP, WSDL, WS-CDL, ...)
- OASIS (UDDI, WS-BPEL, ebXML, SAML, XACML, WSS, ...)
- WS-I (Web Services Interoperability; Basic Profile)
- Vendors (Microsoft, IBM, BEA, Oracle, Sun, HP, ...)

Web Services Evolution
### Web Services Standards

- Standards are being proposed at all levels of the stack
  - Vertical standards (how companies communicate within an industry)
  - Standards for RPC-like communications over the 'net
    - message formats, interface descriptions, discovery of services
  - Standards for integrating the above into existing systems
    - security, transactions, routing etc
- Standards are at different levels of maturity
  - “Standard” is a short-hand for “proposed standard” in many cases
- Real standards require industry consensus
  - Real standards are in many cases “de facto”

### Web Services Stack

<table>
<thead>
<tr>
<th>Discovery</th>
<th>Inspection</th>
<th>UDDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description,</td>
<td>Agreement</td>
<td>Process</td>
</tr>
<tr>
<td>Orchestration,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service</td>
<td>XML</td>
<td>WSDL</td>
</tr>
<tr>
<td>Packaging,</td>
<td></td>
<td>SOAP / XMLP</td>
</tr>
<tr>
<td>Transport</td>
<td>XML</td>
<td>SOAP / XMLP</td>
</tr>
<tr>
<td>Communication</td>
<td>HTTP/SMTP</td>
<td>TCP/IP</td>
</tr>
</tbody>
</table>
Some Web Services “Standards”

<table>
<thead>
<tr>
<th>Other / Related</th>
<th>Liberty Alliance</th>
<th>WSDL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>eBXML</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CPP-CPA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WSRP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UBL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WSLA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WSUUI</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Discovery</th>
<th>DAML-S</th>
<th>DSML</th>
<th>UDDI</th>
<th>WSIL</th>
<th>DISCO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description, Orchestration, Service</th>
<th>BPEL4WS</th>
<th>WSFL</th>
<th>XLANG</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOAP.CP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WSDL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WSCL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WS-C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WSC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WS-T</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Packaging, Transport</th>
<th>XKMS</th>
<th>X-KISS</th>
<th>X-Ml</th>
<th>WS-S</th>
<th>SAML</th>
<th>P3P</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOAP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOAP-SEC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOAP-RP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIME</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XML-RP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XML</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XML-ENC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XML-DIGSIG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XML-RPC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XSII</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Web Services Evolution

- **SOAP**
  - Developed by Microsoft, submitted to W3C in 2000
  - Originally designed to unify and serialize proprietary RPC calls
  - SOAP vs. XML-RPC

- **WSDL**
  - Submitted to W3C in 2001

- **UDDI**
  - Originally developed by UDDI.org, submitted to OASIS
  - Still not widely accepted, optional extension to SOA
SOAP

“Simple Object Access Protocol”

- Specification for invoking methods, services, and objects
- Designed to communicate via Internet
- Platform and language independent
- Can be used in a large variety of systems

SOAP Messages

- Structure
  - A mandatory envelope
  - A set of encoding rules (opt)
  - An convention for RPC (opt)
  - How to model request/response interactions
  - An optional binding to HTTP

- Features include
  - Reliability, Security, Correlation, Routing
  - Message exchange patterns
SOAP Message

```xml
<SOAP:Envelope xmlns:SOAP="http://www.w3.org/2002/06/soap-envelope/"
SOAP:encodingStyle="http://www.w3.org/2002/06/soap-encoding ">
    <SOAP:Header>
        <s:security xmlns:s="secure-URI" SOAP:mustUnderstand="1"> 
            Signature
        </s:security>
    </SOAP:Header>
    <SOAP:Body>
        <m:Deposit xmlns:m="www.xmlbus.com/bankingService">
            <m:amount>200</m:amount>
        </m:Deposit>
    </SOAP:Body>
</SOAP:Envelope>
```

WSDL

- "Web Services Description Language"
  - Describes the point of contact for service provider (Service Endpoint)
  - Provides a formal definition of the endpoint interface
  - Establishes the physical location (address) of the service
- Service Description (or definition)
  - Abstract description – portType (interface), operation, message
    - The interface characteristics of Web Service without any reference to the technology used in implementation
  - Concrete description – Binding, port (endpoint), service
    - The physical connection and addressing
WSDL Structure

```xml
<definitions name="HelloService" ...>
  <message name="SayHelloRequest">
    <part name="firstName" type="xsd:string"/>
  </message>
  <message name="SayHelloResponse">
    <part name="greeting" type="xsd:string"/>
  </message>
  <portType name="Hello_PortType">
    <operation name="sayHello">
      <input message="tns:SayHelloRequest"/>
      <output message="tns:SayHelloResponse"/>
    </operation>
  </portType>
  <binding name="Hello_Binding" type="tns:Hello_PortType">
    <soap:binding style="rpc" ...>
      <operation name="sayHello">
        <input> <soap:body ...> </input>
        <output> <soap:body ...> </output>
      </operation>
    </binding>
  </binding>
  <service name="Hello_Service">
    <port binding="tns:Hello_Binding" name="Hello_Port">
      <soap:address location="http://xxx/yyy"/>
    </port>
  </service>
</definitions>
```

UDDI

- "Universal Description, Discovery & Integration"
  - "Phone book of Services" for fully automated A2A communication
  - A registry for managing information about Web services
  - Not yet fully implemented or used
Using Web Services

- Message Exchange Patterns
  - Request-response
  - Solicit-response
  - Fire-and-Forget
  - Subscription Model
  - Note: WSDL 2.0 defines additional 4 MEP’s

- Discovery
  - Querying the service repository

- Negotiation
  - Communications format specified by a service contract (service “API”)

- Invocation
  - Invoke the service (send a message)
Complex Web Services

- Atomic Transactions: WS-AtomicTransaction
  - Enable cross-service ACID-transactions
- Business Activity: WS-BusinessActivity
  - Enable long-running, complex service activities
- Coordination: WS-C
  - Provides services that introduce controlled structure into activities
- Orchestration: WS-BPEL (BPEL4WS)
  - Establishes a formal business process definition
- Choreography: WS-CDL
  - Governs complex activity with multiple participants

Complex Web Services

- Addressing: WS-Addressing
  - Adds a layer of messaging autonomy
- Reliable Messaging: WS-ReliableMessaging
  - Delivery assurances, acknowledgements, failure reporting, ...
- Policies: WS-Policy
  - Rules, behaviors, requirements, preferences, QoS, ...
- Security: WS-S, XML-Signature, XML-Encryption, ...
  - Identification, authentication, authorization, integrity, ...
- And many more still to come ...
Questions?