Extending SOA Architecture using Generic Service Representative

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Web Services & Cloud Computing

SaaS
Software as a Service: On demand and customizable business applications.

PaaS
Platform as a Service: No need to directly manage OS, databases, etc.

IaaS
Infrastructure as a Service: No need to purchase or manage physical data centers.

SOA Components

Cloud Components

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Traditional (Server-side) Web Services

Data (or Information) Services: processes client data completely at the server site.

- Large Client Data Volume Processing
- Client Privacy & Security Violation
- Limited Functionality
  - Real-time Web Services
  - Event-triggered Web Services
  - Advertising Web Services
Proposed (Client-side) Web Services

- **Knowledge Service:** provides enterprise knowledge for enterprise agents or other services.

- **Task Service:** processes client data partially or completely at the client site using the enterprise agent.
Task Services

- We define “Task” formally as a triple:

  \[
  \text{Task} = \langle \text{Task Model}, \text{Task Knowledge}, \text{Task Data} \rangle
  \]

  \begin{align*}
  \text{Task Model} & : \text{what to do (Business Process Model)} \\
  \text{Task Knowledge} & : \text{how to do it (Business Rules & Actions)} \\
  \text{Task Data} & : \text{resources (Business Data)}
  \end{align*}

- Task Service performs a task at the client’s side; it implies that some of the task data should remain at the client’s side since they can not be transmitted efficiently to the provider.
  - Privacy and security issues
  - Large client data files
Service Representative (SR) is a software agent that performs a task on behalf of a service provider at the client side.
Data & Task Service Invocations

1. Remote Service Parameters
2. Remote Service Responses

Client Application

Data Web Service

1. Remote Service Parameters
3. Task

Service Representative

Task Web Service

2. Local Service Parameters
4. Local Service Responses

Client Application
A typical financial adviser data service asks for the client's financial information in order to provide personalized advice.
## Task Service Example

### Secure Financial Adviser

#### Task Model

<table>
<thead>
<tr>
<th>Task Model</th>
<th>Task Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Start</strong></td>
<td>Let ( b = \text{buyAdvice}. \text{stock} &amp; \text{minB} = \text{buyAdvice}. \text{minPercentage} ) Let ( s = \text{sellAdvice}. \text{stock} &amp; \text{maxS} = \text{sellAdvice}. \text{maxPercentage} )</td>
</tr>
<tr>
<td><strong>Valid\text{buy}?</strong> (Business Rule)</td>
<td>If ( (b \notin \text{holdings Or holdings. b. percentage} &lt; \text{minB}) ) Then Return ”Yes”</td>
</tr>
<tr>
<td><strong>Print Buy</strong></td>
<td>required\text{Cash} = (\text{minB} - \text{holding. b. percentage}) * \text{holdingsValue}</td>
</tr>
<tr>
<td><strong>Advice</strong> (Business Action)</td>
<td>Print (“Buy” + \text{shareNo} + “of” + \text{b})</td>
</tr>
<tr>
<td><strong>Valid\text{sell}?</strong> (Business Rule)</td>
<td>If ( (s \in \text{holding And holdings. s. percentage} &gt; \text{maxS}) ) Then Return ”Yes”</td>
</tr>
<tr>
<td><strong>Print Sell</strong></td>
<td>earned\text{Cash} = (\text{holdings. b. percentage} - \text{maxS}) * \text{holdingsValue}</td>
</tr>
<tr>
<td><strong>Advice</strong> (Business Action)</td>
<td>shareNo = earned\text{Cash} / \text{stockPrice}</td>
</tr>
<tr>
<td><strong>End</strong></td>
<td>Print (“Sell” + \text{shareNo} + “of” + \text{s})</td>
</tr>
</tbody>
</table>

#### Task Data

- generalBuyAdvice = \{\text{buyAdvice} \mid \text{buyAdvice} =<\text{stock, price, minPercentage}>\}
- generalSellAdvice = \{\text{sellAdvice} \mid \text{sellAdvice} =<\text{stock, price, maxPercentage}>\}

#### Client Data

- holdings = \{\text{stock} \mid <\text{symbol, percentage}>, \text{holdingsValue}, \text{cash}\}
Knowledge Service Example

Medical Guidelines

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Composite Web Services

- Collaborating data, knowledge, and task services provide a composite web service.
- A composite task service is modeled by a BPEL process including both data/knowledge and task service invocations.
Proposed Architecture
Prototype System

Snapshot of the prototype service representative manager (*EntRep version 1.1*) that is running a composite task service.
Client-side Processing Technologies

Client-side Script
- Client Data
- Web Browser
- Request Message
- HTML + Client-Side Script (Java Script, VB Script)
- Server-Side Script (ASP, JSP, PHP, …)

Rich Internet Application (RIA)
- Client Data
- Web Browser
- Request Message
- Plug-in (Silverlight, etc)
- (Silverlight, Applet, Flash) file
- Server-Side Script (ASP, JSP, PHP, …)

Task Services
- Client Data
- Client App
- Request Message
- Task Message (Model, Knowledge, Data)
- Web Service
- Links
- Communication Channel
- Service Representative

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## Comparison

<table>
<thead>
<tr>
<th></th>
<th>Script-based Technologies</th>
<th>Rich Internet Applications</th>
<th>Task Services</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Requirements</strong></td>
<td>Web Browser</td>
<td>Web Browser + Plugin (Silverlight, Flash Player, JVM)</td>
<td>Host Application (e.g., Web Browser, Desktop App, Mobile App) + SR Plug-in</td>
</tr>
<tr>
<td><strong>Local Data Access</strong></td>
<td>WebSQL, WebStorage</td>
<td>Local DB Manager</td>
<td>Communication Channel</td>
</tr>
<tr>
<td><strong>Composability</strong></td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Flexibility</strong></td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
</tbody>
</table>
An Experimental Evaluation
Case Study: Face Detection

- **Face Detector Data Service:** Service client sends images to the server to be processed remotely.

- **Face Detector Task Service:** Service provider sends skin detection and face detection algorithms to the service representative to detect faces locally.
Data Service Vs. Task Service

Service Response Time

Average Response Time

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Task Service Vs. Silverlight

Service Response Time
## Conclusion

Data, Knowledge, and Task web services are complementary and have their own applications and features.

<table>
<thead>
<tr>
<th>Type</th>
<th>Applications</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Services</td>
<td>Server-side processing of the non-sensitive client’s data</td>
<td>- Integrated service logic</td>
<td>- Violating the client’s privacy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Easy to assess the service reliability</td>
<td>- Increasing the network traffic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Maintaining the enterprise privacy</td>
<td>- Increasing the service response time</td>
</tr>
<tr>
<td>Knowledge Services</td>
<td>Service-to-Service (S2S) and Service-to-Representative (S2R) transactions</td>
<td>- Maintaining the client’s privacy</td>
<td>- Revealing the enterprise knowledge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Reducing the network traffic</td>
<td>- Client’s responsibility to apply the knowledge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Improving the service response time</td>
<td></td>
</tr>
<tr>
<td>Task Services</td>
<td>Client-side processing of the confidential, large volume, or real time client’s data.</td>
<td>- Maintaining the client’s privacy</td>
<td>- Distributed service logic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Reducing the network traffic</td>
<td>- Difficult to assess the service reliability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Improving the service response time</td>
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