Applying Web Services Technologies to the Management of Context Provisioning

M. Brenner, M. Schiffers

Department of Informatics, University of Munich
Email: brenner@informatik.uni-muenchen.de
Context Provisioning

Role Model

Context Provider
  ↓
CAS Provider
  ↓
Context Owner
CAS User
CAS Customer

Value Chain

Sensor

Context Aware Service

Sensing → Refinement → Dissemination → Usage

User
“Personalized Allergy Forecast”

- Lower level context refined to higher level context
- Many value chain possibilities

![Diagram showing the relationship between various factors affecting allergy profiles and expected exposure.](image-url)
Delivering Context to CAS Providers

Context Provider provides Expected Allergen Exposure to CAS Provider, which consumes it. Context Aware Service provides "Personalized Allergy Forecast" to the Context Provider.
Basic Context Provisioning Role Model

- Context Provider not concerned with details of context usage
- Consumer not concerned with realization of context provisioning
QoC in Context Provisioning

- Context Consumer (e.g. CAS provider) demands specified level of QoC
- Context Provider guarantees QoC levels
Using Web Services for context provisioning

- Standardization of context services needed
- Context Aware Services and typical Web Services scenarios share many characteristics

➔ Idea: Apply Web Services concepts and technologies to context provisioning and its management

```xml
<contextInformation type="allergen...">
  <qoc>
    <precision value="98"/>
  </qoc>
  <informationItems>
    <allergenExposure value="55"/>
  </informationItems>
</contextInformation>
```
Using Web Services for context provisioning

- Standardization of context delivery needed
- Context Aware Services and typical Web Services scenarios share many characteristics

- Idea: Apply Web Services concepts and technologies to context provisioning and its management

- SOAP for context dissemination
- Service description in WSDL
- Access to sensors and refinement functions through SOAP Interfaces
Choosing the Refinement Function

• Same type of context information can be produced by different refinement functions

• Incorporating “optional” context can improve precision, accuracy…

→ Choice of refinement influences QoC of produced context
Describing Workflow with WS Orchestration Languages

• Web Services Orchestration Languages
  - Description of Web Services workflow
  - **Vision:** Workflow executable on orchestration servers

BPEL4WS-example:

```xml
<sequence>
  <receive partnerLink="cConsumer" ... />
  <switch>
    <case condition="bpws:getVariable..."><invoke ... partner="Refine2" ... />
    </case>
    <otherwise>
      <invoke ... partner="Refine1" ... />
    </otherwise>
  </switch>
  <reply ... partnerLink="cConsumer" ... />
</sequence>
```
Gathering Input for the Refinement Function

- Same type of context can be sensed or refined
- User and sensor mobility
- QoC of sources varies

→ Best context sources cannot always be known in advance
→ Possible redundancy of sources
Choosing Context Sources

<sequence>
  <receive partnerLink="cConsumer" ... />
  <switch>
    <case condition="bpws:getVariable...">
      <invoke ... partner="Sensor" ... />
    </case>
    <case condition="bpws:getVariable...">
      <invoke ... partner="Cache" ... />
    </case>
    <otherwise>
      <throw ... />
    </otherwise>
  </switch>
  <reply ... partnerLink="cConsumer" ... />
</sequence>

Evaluate QoC/QoS requirements

[sensor access time < required response time]

[last cache update > required up-to-dateness]

Query Sensor

Query Cache

Return Result

Return Fault
Finding Context Sources: Context Brokers

- Context Broker providing a context source registry
- UDDI as underlying technology
Problem of Trustworthiness

• Provider is source of QoC information
  ➔ Not a good approach for trustworthiness!
  ➔ All other QoC information questionable without trustworthiness

• How to interact with possibly untrustworthy partners?
  ➔ Provider-independent source of trustworthiness information
  ➔ Using a trusted intermediary
Additional Roles: Rating Repository

- Provides ratings of context providers
- Ratings by sample tests or former partners
Additional Roles: Context Escrow

- Acts as proxy during context provisioning
- Offers escrow and validation services
Conclusion

• Management challenges of context provisioning and web services are quite similar

• Many Web Services concepts and technologies can be applied to context provisioning
  – Web Services as middleware for context provisioning
  – UDDI as technology for context brokers
  – SOAP intermediary for Context Escrow
  – Web Services Orchestration Languages for controlling Context Provisioning workflow
Current Work

• Further analysis of suitability of Web Services Orchestration Languages for Context Provisioning
  – BPEL4WS
  – BPML
• QoC definitions and provisioning workflow patterns for common types of context
• Testbed for “allergy forecast” prototype
• Evaluation of Web Services security mechanisms