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Applying Web Services Technologies to the Management of Context Provisioning

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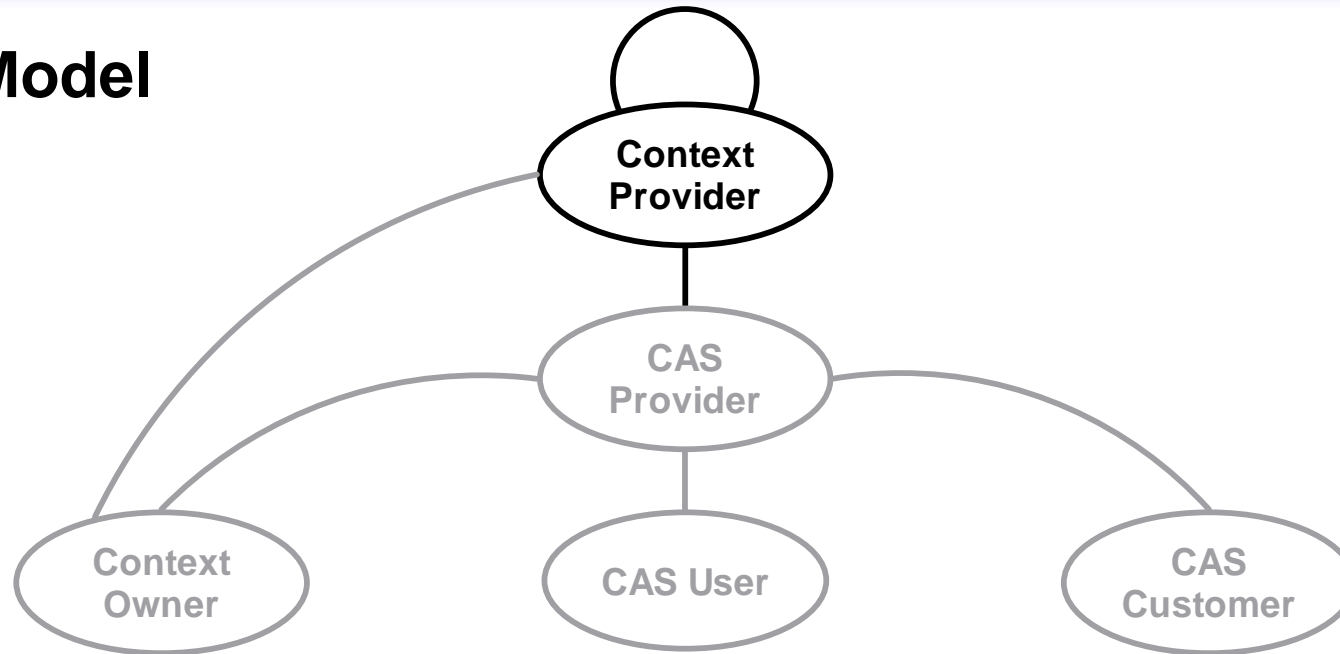


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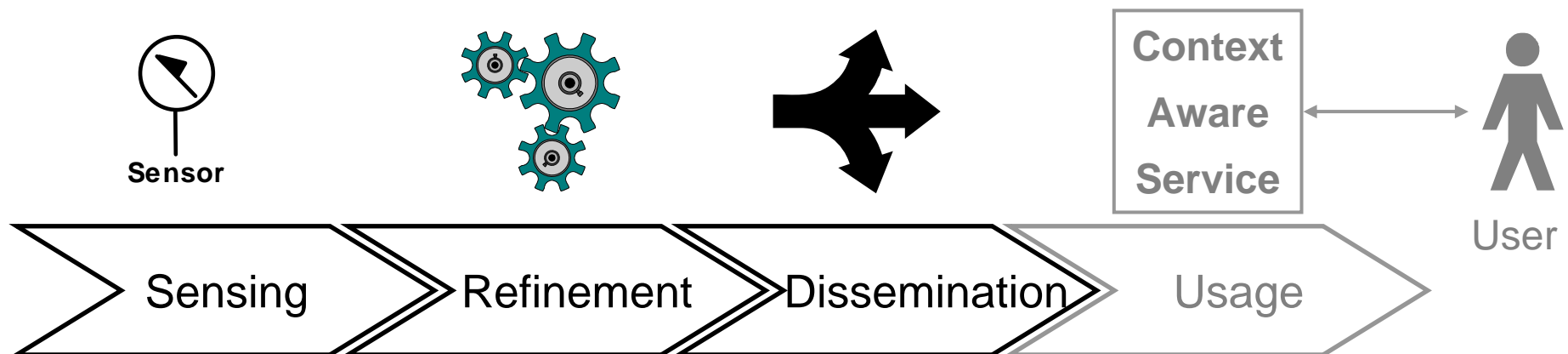
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Context Provisioning

Role Model

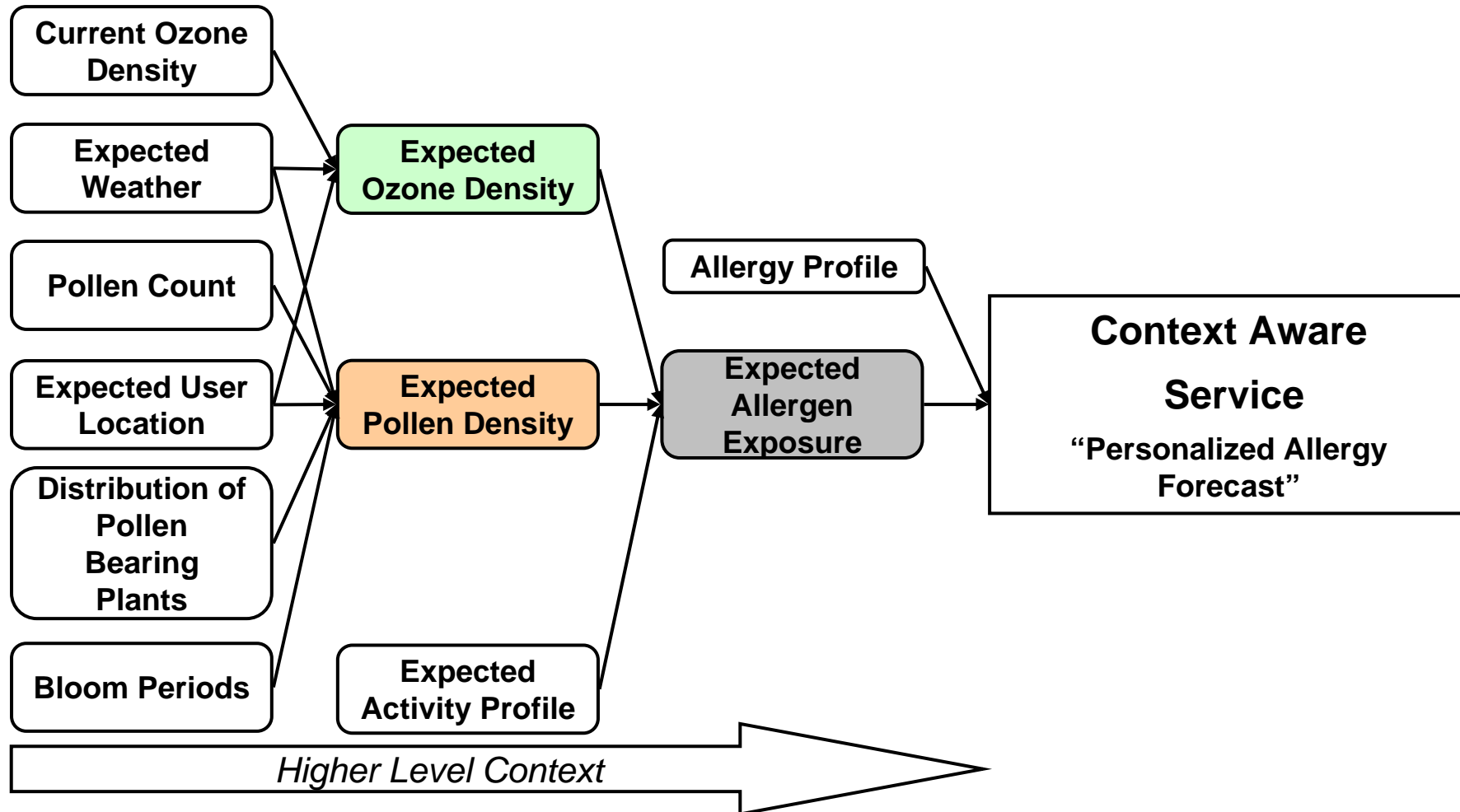


Value Chain

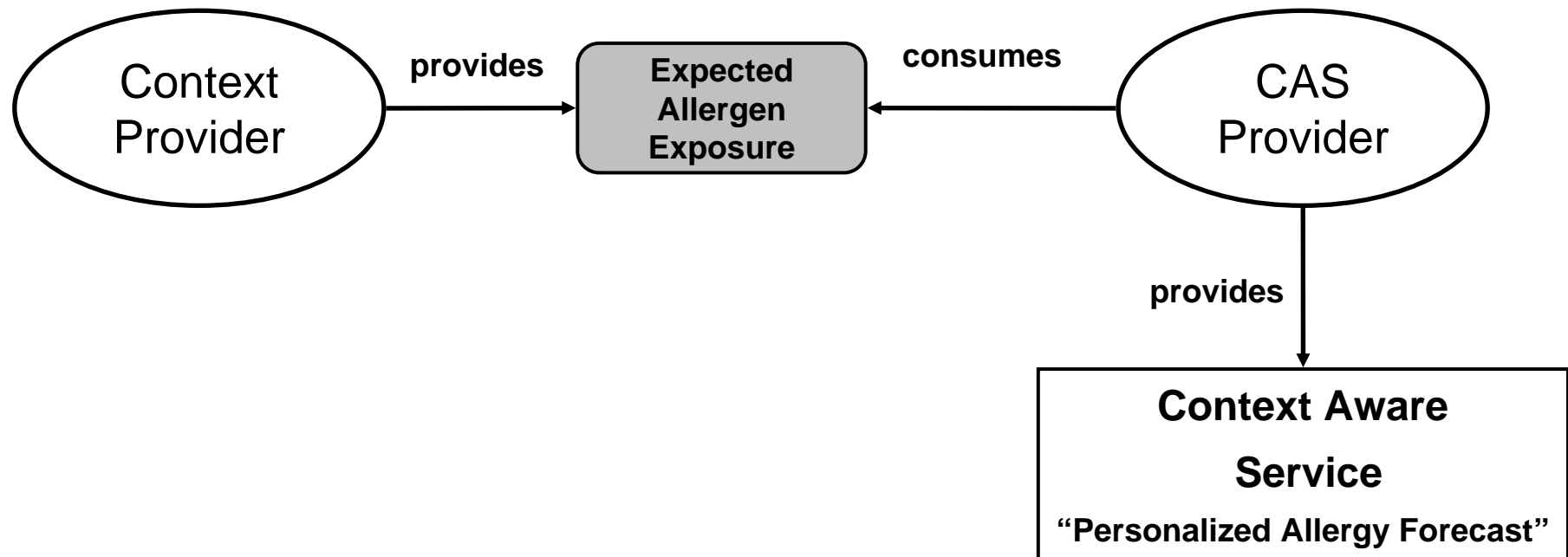


“Personalized Allergy Forecast”

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

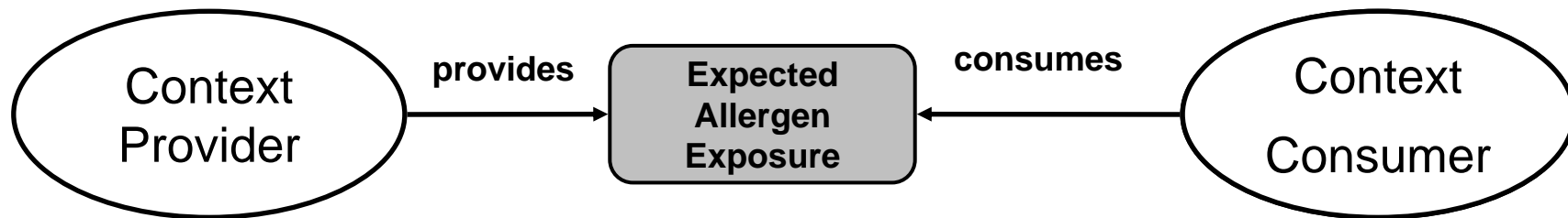


Delivering Context to CAS Providers



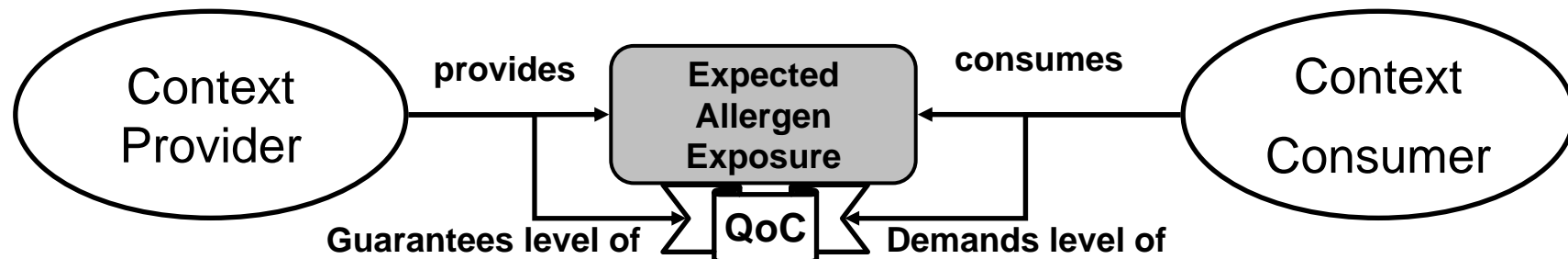
Basic Context Provisioning Role Model

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



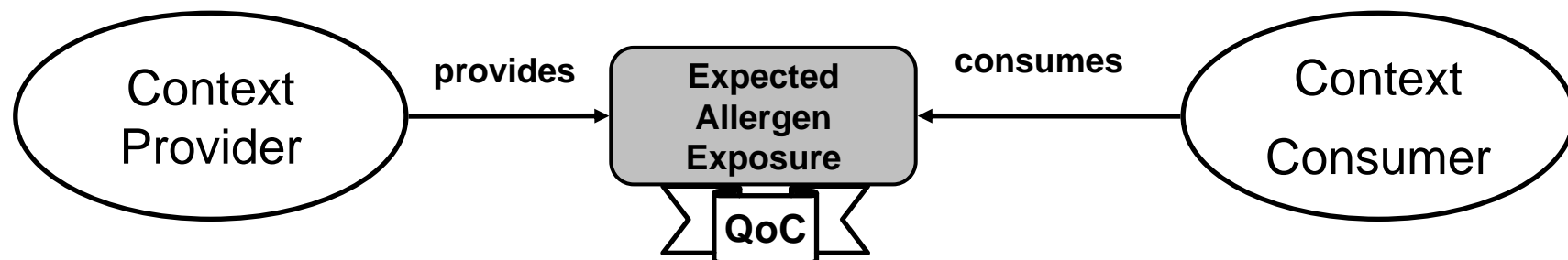
QoC in Context Provisioning

- Context Consumer (e.g. CAS provider) demands specified level of QoC
- Context Provider guarantees QoC levels



Using Web Services for context provisioning

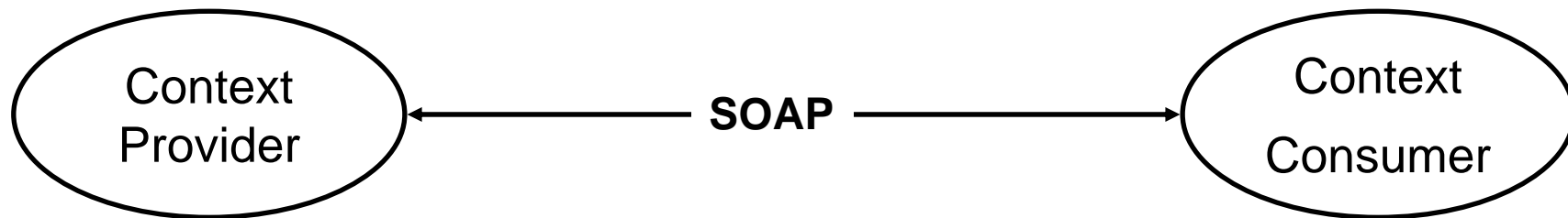
- Standardization of context services needed
 - Context Aware Services and typical Web Services scenarios share many characteristics
- ➔ Idea: Apply Web Services concepts and technologies to context provisioning and its management



```
<contextInformation type="allergen...">
  <qoc>
    <precision value="98"/>
  </qoc>
  <informationItems>
    <allergenExposure value="55"/>
  </informationItems>
</contextInformation>
```

Using Web Services for context provisioning

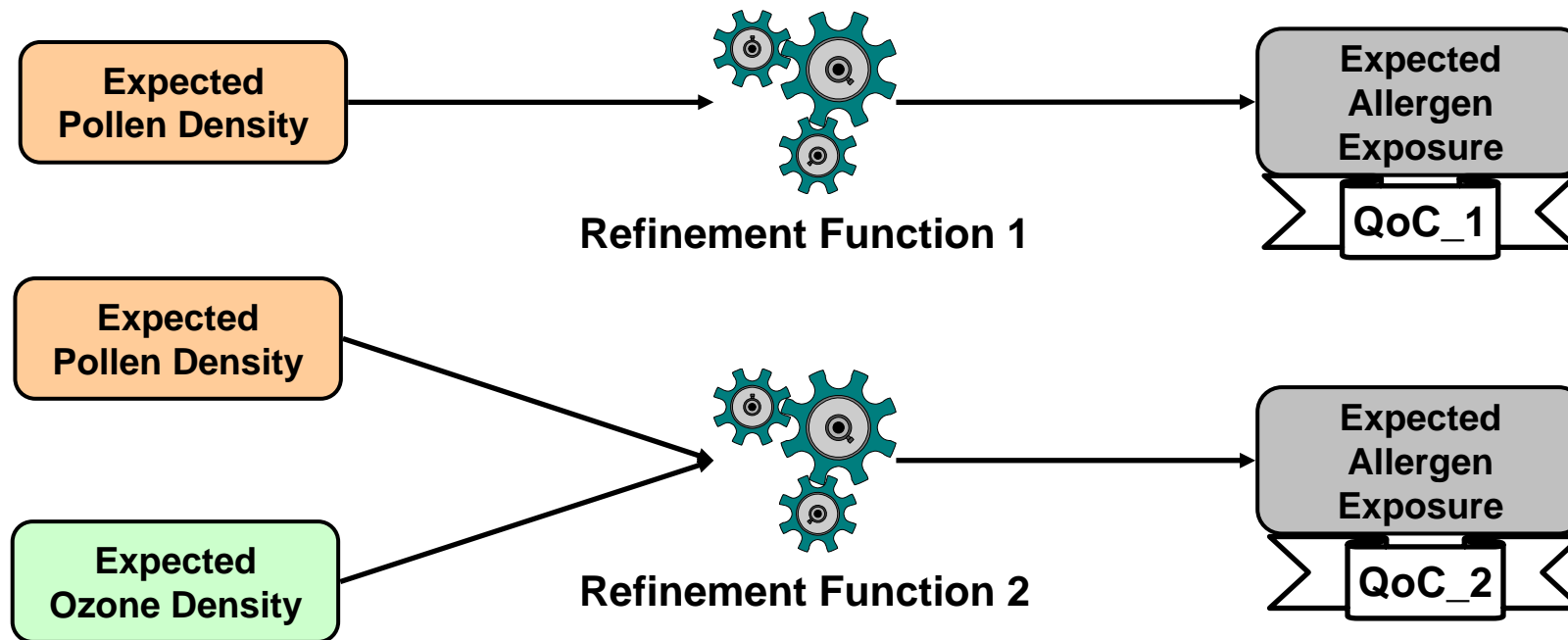
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 - Context Aware Services and typical Web Services scenarios share many characteristics
- ➔ Idea: Apply Web Services concepts and technologies to context provisioning and its management



- ➔ 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



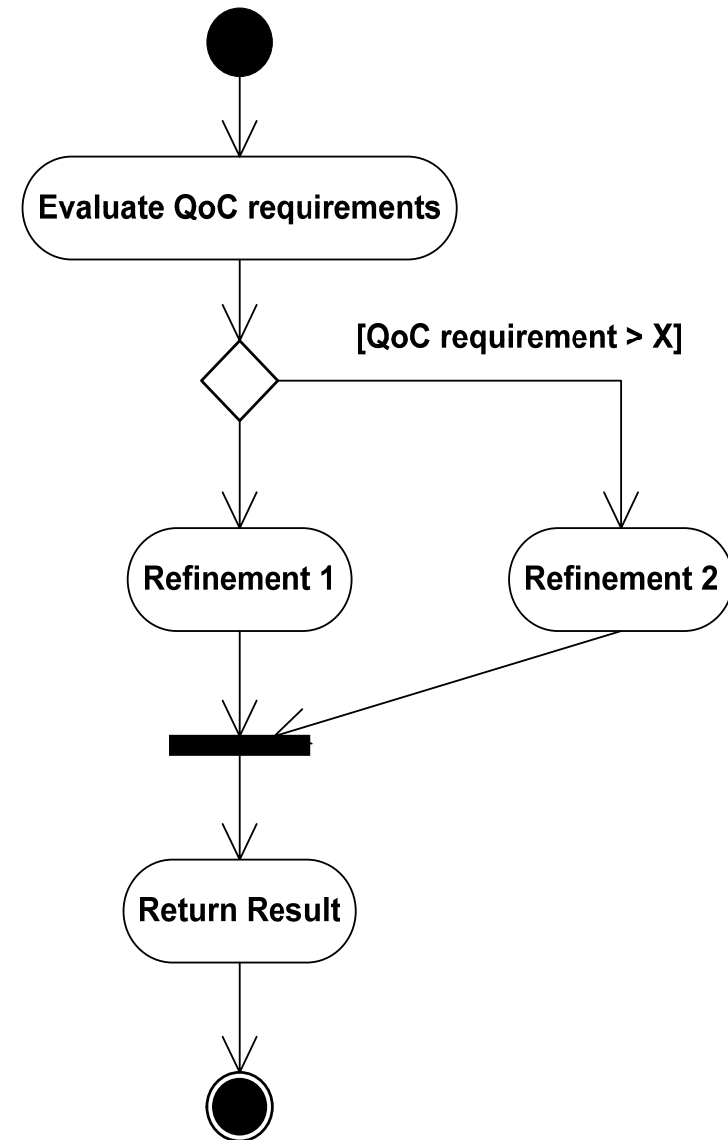
Describing Workflow with WS Orchestration Languages

• Web Services Orchestration Languages

- Description of Web Services workflow
- Vision: Workflow executable on orchestration servers

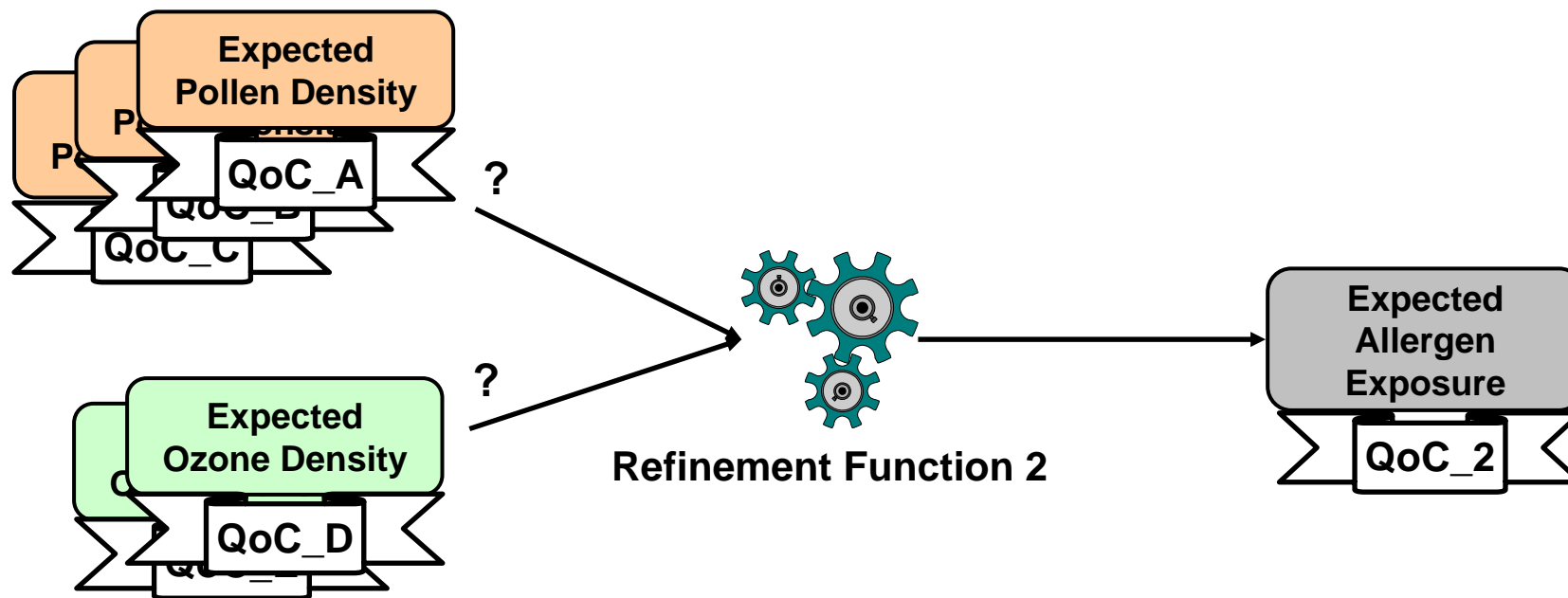
BPEL4WS-example:

```
<sequence>
  <receive partnerLink="cConsumer" ... />
  <switch>
    <case condition="bpws:getVariable...">
      <invoke ... partner="Refine2" ... /> ...
    </case>
    <otherwise>
      <invoke ... partner="Refine1" ... /> ...
    </otherwise>
  </switch>
  <reply ... partnerLink="cConsumer" ... />
</sequence>
```



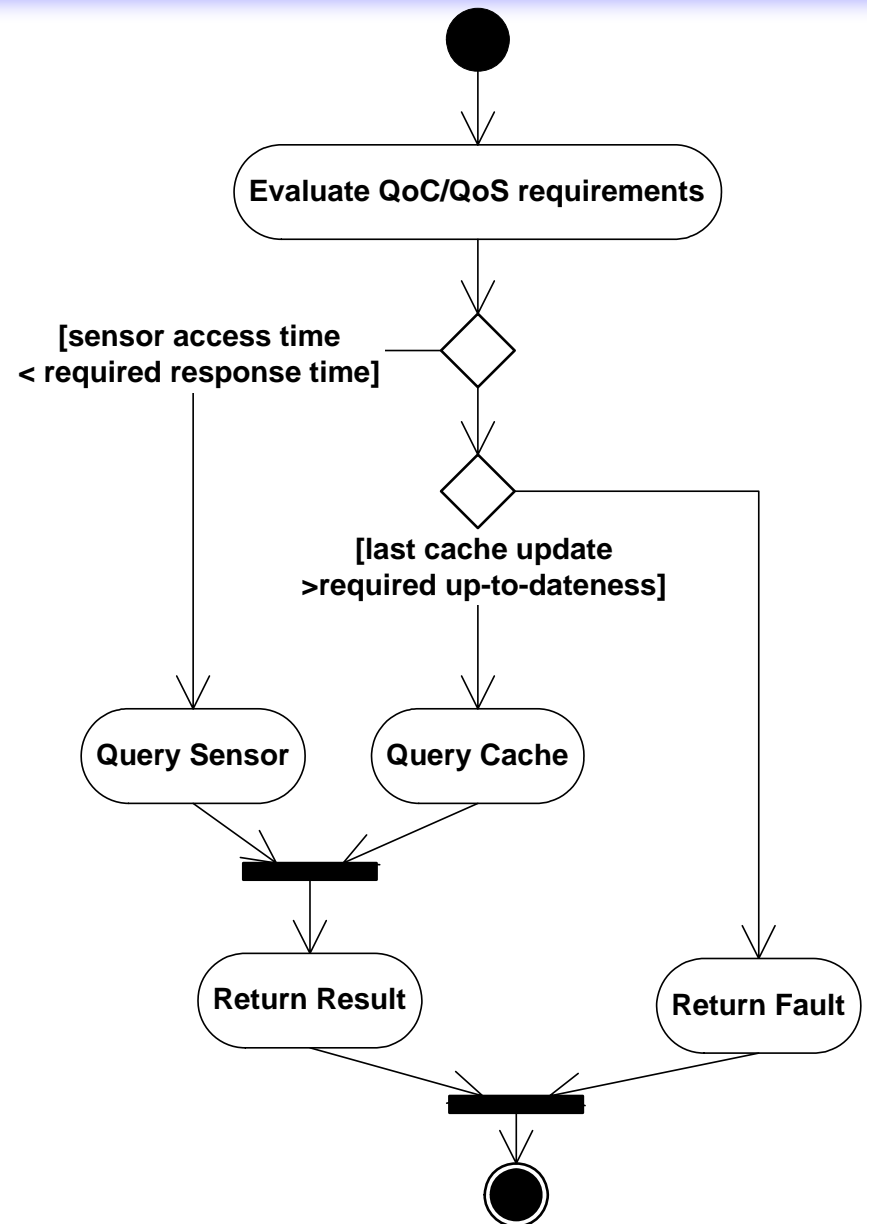
Gathering Input for the Refinement Function

- 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



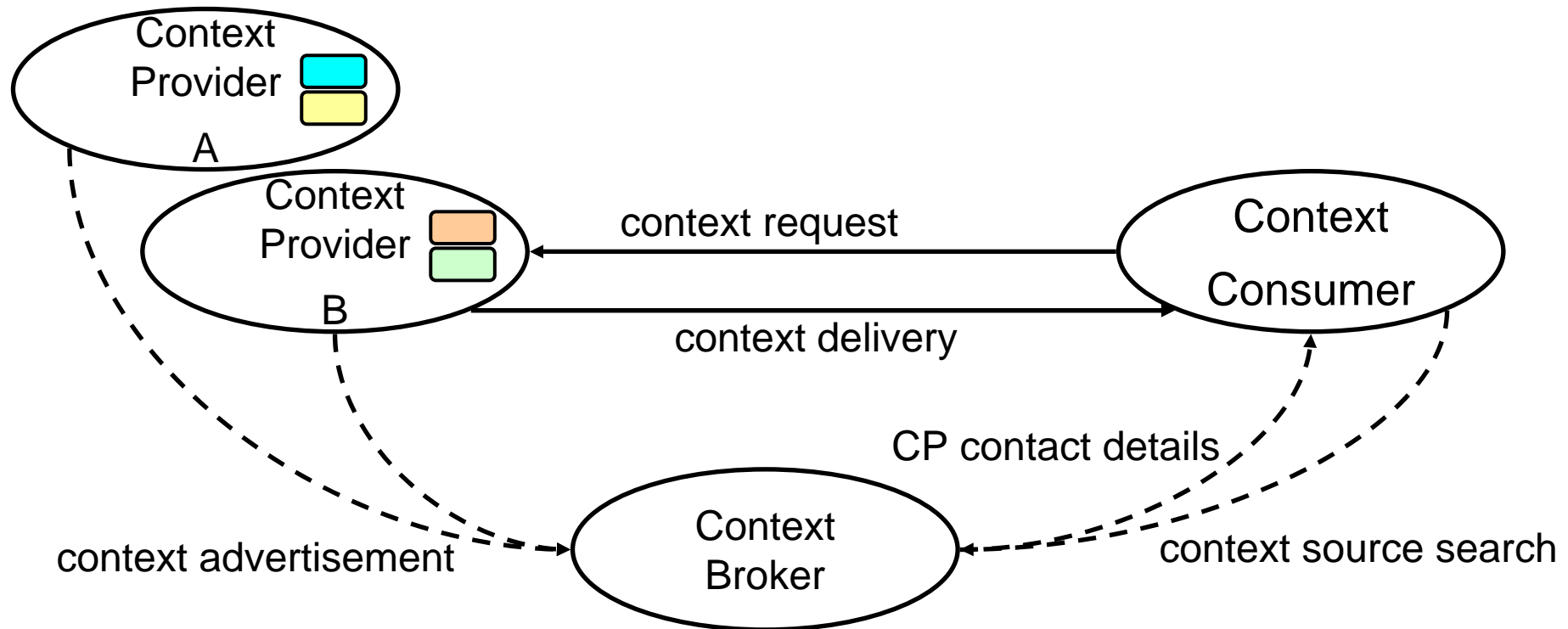
Choosing Context Sources

```
<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>
```



Finding Context Sources: Context Brokers

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



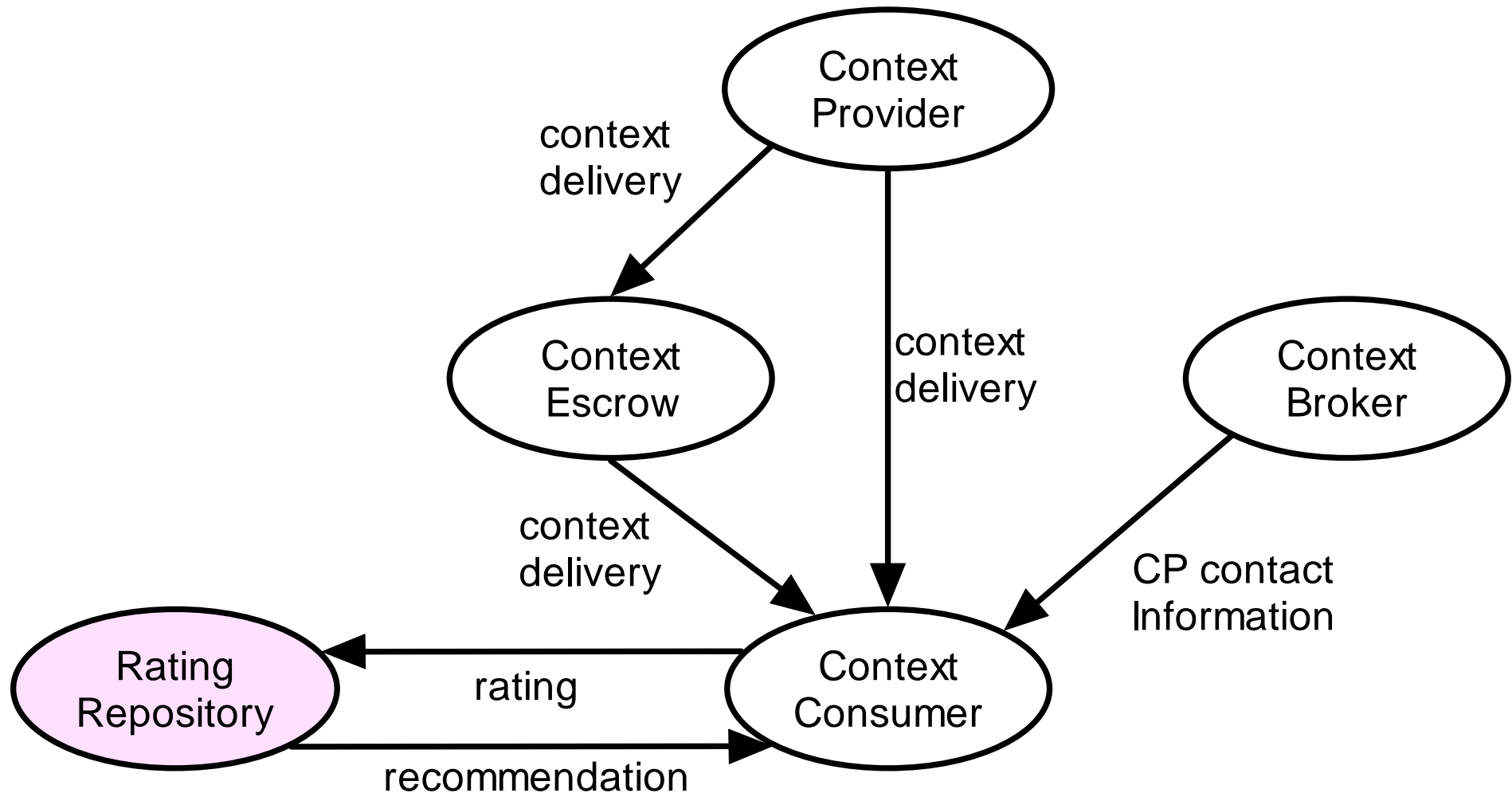
Problem of Trustworthiness

- 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

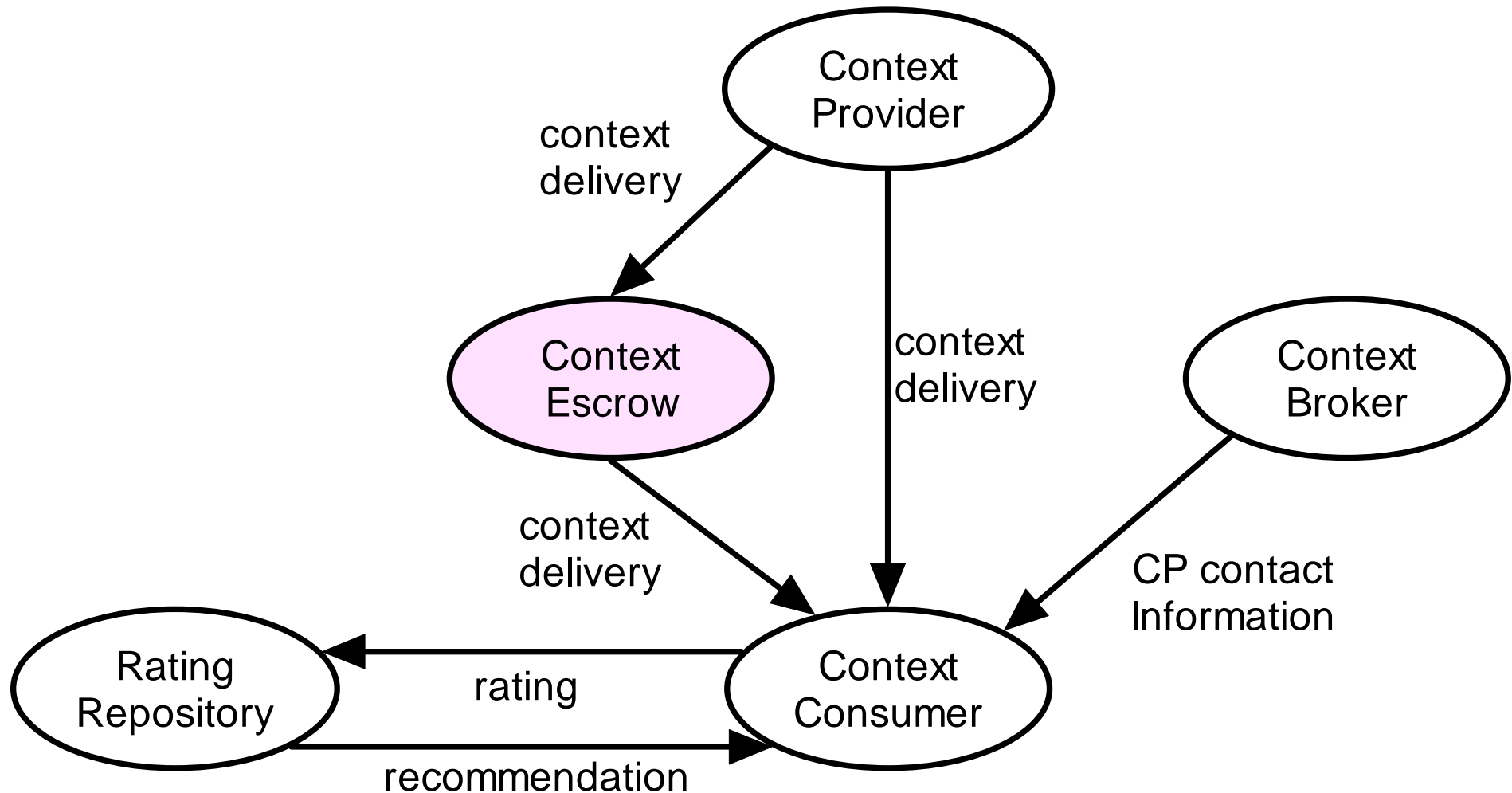
Additional Roles : Rating Repository

- Provides ratings of context providers
- Ratings by sample tests or former partners

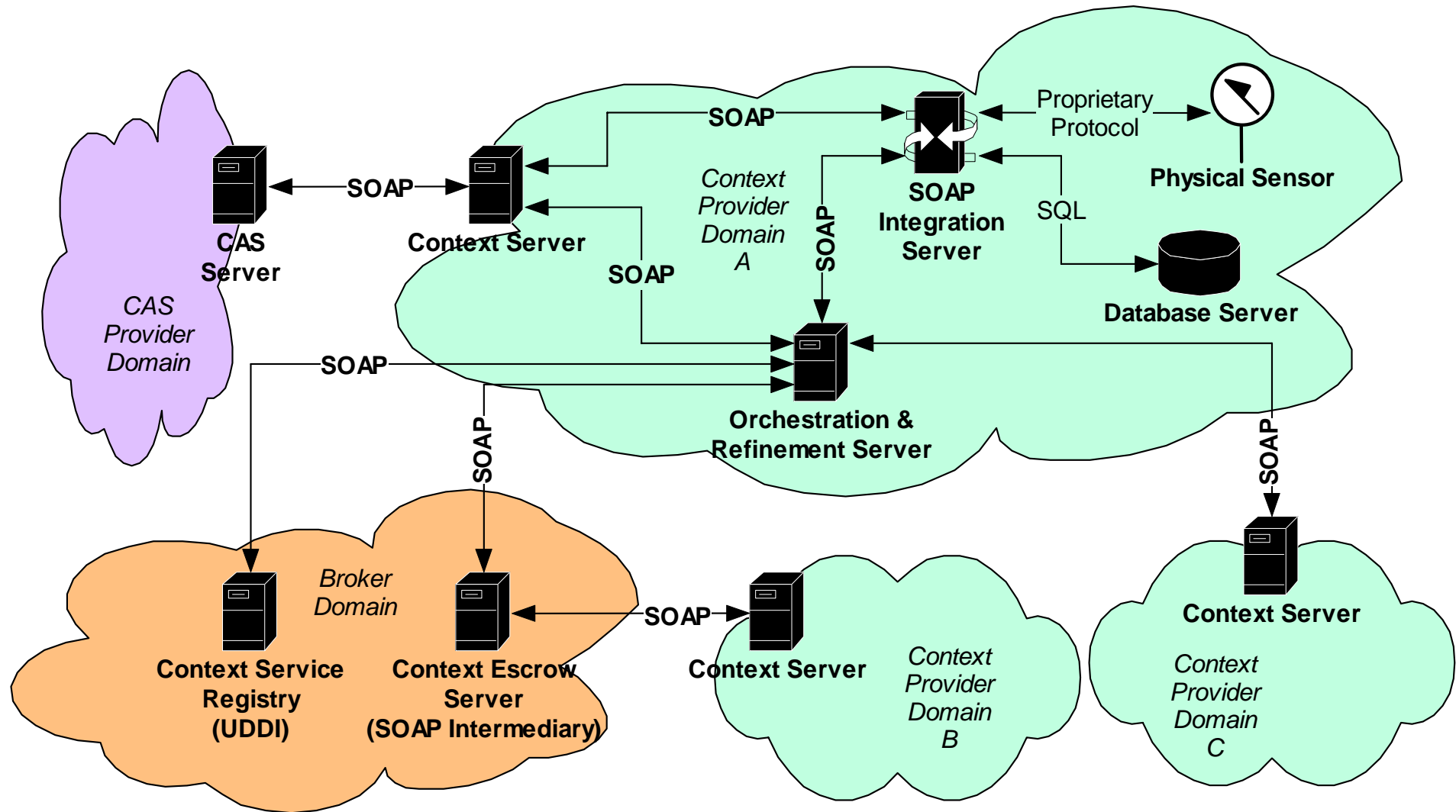


Additional Roles : Context Escrow

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



Context Provisioning with Web 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