Chapter 7

Summary and Conclusion

7.1 Summary
As a large number of web services with similar functionalities are published in the registry by different service providers nowadays, the service consumers are flooded with the services. Smart Web Service Discovery mechanism mainly emphasizes on finding the service that best fits the consumer’s requirement. For finding the best service that meets the consumer’s requirement, he must be able to specify his functional and QoS requirements along with his priorities. However, current UDDI registries do not provide any mechanism for service providers to publish and store the QoS information of their services in the registry. Moreover, the published QoS information of the services may not be always trustworthy and hence need some monitoring mechanism which will assure the service consumers about the QoS information published by the service providers. Also service consumers need a good registry browser tool which will be user friendly using which consumer will be able to specify his service discovery request with functional and QoS requirement with his priority for QoS for optimum service selection.

We are proposing a monitor-enhanced web service discovery model, Smart Web Service Discovery (SWSD). The QoS information published by the service provider is stored using tModels in a UDDI registry and is expressed in XML format. Using SWSD, when a service consumer sends a service discovery request, the discovery agent will find functionally and QoS matched services from the UDDI registry, retrieve monitor ratings, calculate monitor score and based on consumer’s requirement of monitor score, the optimum services will be ranked on the overall score (ie. QoS and Monitor score) and
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returned to the consumer. Service Monitor will be regularly monitoring the published services and rate them based on their actual QoS values on monitored timestamp.

7.2 Contribution

In this research study, we have examined some of the existing web service discovery mechanisms and identified some major issues and challenges in publishing service QoS information and finding the appropriate service that best meet the service consumer’s requirement by matching published QoS with consumers QoS requirement. Also there was a major concern regarding trustworthiness of published QoS as it was published by the service providers themselves. As a solution, we have proposed a monitor-enhanced web service discovery model, Smart Web Service Discovery (SWSD). We have stated the service matching, rating, ranking and selection algorithm in this model to tackle the optimum service discovery issue.

We have developed a discovery model with a discovery agent and a service monitor. The discovery agent finds services those best satisfy a service consumer’s functional, QoS and Monitor requirements that are specified in a discovery request. The Service Monitor monitors the published services by invoking them over the regular time interval and based on this, rates them on each monitored timestamp. These ratings are stored in the ratings table and fetched by the discovery agent to calculate a monitor score for each QoS and functionally matched services to rank them during the discovery process.

We have also developed a user-centric registry browser tool which will be assisting the service consumer to specify the functional as well as QoS and monitor requirements in a service discovery request which will also allow the consumer to specify the QoS priority. To store published QoS information of services, a current feature in UDDI registry – tModel is used. When a business publishes a new web service, it creates a tModel in a UDDI registry. The QoS information of the web service is expressed in XML format in tModel which is referenced in a bindingTemplate of a web service.

We have stated service matching, rating, ranking and selection algorithms to find the services that match service consumer’s requirements, to rate the services, to rank the matched services using their QoS and Monitor scores and to select services based on the service consumer’s priority in the service discovery request.

After implementing the SWSD model, we have evaluated the model by conducting
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experiments. For the experiment purpose, before sending the service discovery requests, a large number of web services (approximately 1000) with different combinations – different functionalities and different QoS, similar functionalities and different QoS, similar functionalities and similar QOS, different functionalities and similar QoS were published in the UDDI registry. In the experiment, different consumers send the service discovery request with different functional, QoS and Monitor requirements. At the end we discussed the experimental results which demonstrate that the proposed service discovery model (SWSD) can find the most appropriate web service for the service consumer.

7.3 Conclusion
From the research study, we conclude that :

- The proposed Smart Web Service Discovery (SWSD) model provides a simple solution to a service discovery problem with less complexity at the same level of standards such as WSDL and UDDI as compared to other models based on WSLA.
- A Service Monitor in our model helps a service discovery agent to increase the chances of finding the services that provide assured QoS performance consistently and that match consumer’s QoS and monitor requirements by assigning ratings to each service and providing those ratings to service discovery agent for optimum service selection.
- The monitor score based on historical service monitor ratings are playing crucial role in finding the service with high assurance of QoS and that best fit for the consumer’s requirements. The sensitivity of monitor scores to changes in the monitor ratings is adjusted by the inclusion factor.

Summarized observation from the research work is given in the table below:
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Table 7.1: Summarized comparison of results obtained

<table>
<thead>
<tr>
<th>Observation</th>
<th>Existing UDDI registry browser - UB 0.2</th>
<th>SWSD with Functional match</th>
<th>SWSD with Functional and QoS match</th>
<th>SWSD with Functional, QoS match and QoS preference</th>
<th>SWSD with Functional, QoS match with QoS preference and Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of web services found</td>
<td>50</td>
<td>05</td>
<td>05</td>
<td>05</td>
<td>05</td>
</tr>
<tr>
<td>Relevancy of Services</td>
<td>Less</td>
<td>Less</td>
<td>More</td>
<td>More</td>
<td>More (with assured QoS)</td>
</tr>
</tbody>
</table>

7.4 Future Enhancements

There is a saying about software projects as - “A software project is never finished, only abandoned”. Consequently, there is always scope for the improvements in the design and implementation of any software project. Some of the important issues that should be addressed in any future implementation or enhancement are listed below:

1. In future, integration of semantic information of services into Smart Web Service Discovery could be investigated in order to increase the flexibility and accuracy of the service discovery. Semantic-based service categorization and semantic-based
service selection will extend the service discovery from only syntactical information to a semantic level which may lead to more precision and relevance of the discovered services.

2. For automated service discovery, integrating Smart Web Service Discovery framework with the service consumer application would be one of the interesting project.

3. Smart Web Service Discovery may be further enhanced with the capability to allow the service consumer to specify their own QoS parameters and its values at the same time providing the default QoS parameters in absence of the user specified QoS parameters.

4. As service monitor regularly monitors all the published services in the UDDI registry and there may thousands of services registered in the registry in every month, there is large overhead on the monitor to rate each and every service though some of them may be continuously rated bad. Hence there is a need to improve Service Monitoring by keeping the services with consistent bad rating out of monitoring and increase the performance of discovery mechanism.