Chapter 1

Introduction

1.1 Overview

In recent years, Web services are considered as the major technique to solve the challenges in distributed web applications. Current trend shows that the vast majority of companies are moving to Services Oriented Architectures (SOAs) and deploying Web services within and across their Information Technology (IT) infrastructure. Web services are self-contained and self-describing application components. A composite service is a service whose implementation calls other services. Also, Web services are becoming a major technique for building loosely coupled distributed systems. The success of Web services for Business to Business (B2B) integration depends on the selection of Web services and its composition. However, selection of a Web service that matches the user’s requirement from the list of services with the same functionality needs more efforts to avoid dissatisfaction. The customer needs to know the quality of the offered Web services as well as the price that they should pay for that quality. Apart from the functional requirements, the quality related aspects are also considered for the best selection [3]. In order to survive the competition created by the new online economy, companies need to choose and implement the right software and technology solution. They should also find an integrated, robust e-business solution that allows them to leverage the existing applications, rapidly adapt to the unique needs of their business and continually evolve as business requirements change over time [73].
1.2 Motivation

In distributed environments, the use of services without any quality guarantee from the service providers can negatively affect a composite service by raising intermittent failures or having a slow performance of one of the services. The performance of the Service Oriented System (SOS) is highly relying on the performance of the employed Web services. Quality-of-Service (QoS) is usually engaged for describing the non-functional characteristics of a Web service. There are many cases that a service cannot meet the consumer’s service requirements in respect to quality and content. The provision of QoS is seen as a compromise between the customer requirements and the ability of the service provider to satisfy the customer. However, many of the quality of service requirements of the customers are being ignored. After selection, it is always not true that the Web services meet the consumer’s requirements and the clients think that they are paying for the service that is undelivered [84]. Hence, a method is needed to automate the costing of Web services based on the offered QoS. The main motivation of this work is to find the optimal correlation between the cost and quality of the Web service.

1.3 Problem Definition

The prime motive of service-orientation is to develop composite services, by reusing well known functionality provided by other services in a low-cost for rapid development process. One of the major and current trends in software engineering is the development of applications created from independently developed Web services. However, in distributed environments, the use of services with poor performance negatively affects the functionality of composite service and fails to satisfy the user
requirements. Another major problem is that, normally the QoS evaluation is not based on the actual functionality of the Web service. Providers offer similar competing services corresponding to a functional description of services. These offerings can differ significantly in some QoS attributes like performance. The customer satisfaction is based on the service functionality and the cost spent for the offered quality. However, existing QoS evaluation method does not guarantee the user’s requirement in terms of its functionality. Hence it is required to have a costing method that evaluates the QoS purely based on the functionality of the Web service.

1.3.1 Research Questions

The aforementioned problems raise the need for a method to effectively develop the QoS-aware Service Oriented System. In particular, this thesis is guided by the following four main research questions including a set of sub-questions to further structure the main questions.

Q1: How to reach the maximum functionality of a Web service?
- Which attributes have to be considered for reaching the functionality of a Web service?
- How to assign the weights for the non-functional parameters?

Q2: How to evaluate the QoS based on the functionality?
- Which aspects have to be considered to evaluate the QoS of a Web service?
- How can the QoS be effectively monitored using the non-functional parameter values?
- What extend the functionality based weight fixing is useful for QoS evaluation?
Q3: How to reach an optimal correlation between the QoS and cost of a Web service?

- How to calculate the cost of the Web service as per the offered QoS?
- What extend both the signing parties satisfied with the QoS based cost calculation?

Q4: What are the management decisions to be taken in case of any deviation?

- Which aspects have to be taken care when there is a deviation from the guaranteed level of QoS?
- What are the updates required for the service to reach the maximum functionality?

1.4 Thesis Contribution

This research work aims to contribute to the development of a system that automatically calculates the cost of the Web service purely based on the quality offered by the provider, thereby, satisfy the customer in terms of quality, the provider in terms of cost as per the actual measures mutually agreed by both of them.

The primary goal behind this work is to address the quality related challenges faced by most of the enterprises that have decided to adopt the Web service technology. In this thesis, an architecture has intended and proposed, that provides the optimal correlation between the quality and the cost of the Web service. The work can be described as follows:

(1) Assertion of QoS by assigning functionality based weight for the non-functional parameters

The quality of a Web service is mainly viewed through the performance of the non- functional parameters. This work contributes to assert the QoS of a Web service by
assigning weights to each non-functional parameter apart from actual parametric values. In this research, the appropriate weights are assigned to the non-functional parameters based on the functionality of the Web service during its selection. The assignment of weight is made by analyzing the domain specific and independent attributes that influence the functionality of the Web service. The advantages of functionality based weight fixing over equal weight parameters are also explained.

(2) Evaluation of actual QoS of the Web services

The QoS of the Web service is based on the extent to which how long the user requirements are satisfied. QoS is usually employed for describing the non-functional characteristics of Web services and viewed as an important differentiating point for various Web services. In order to achieve efficient evaluation, this investigation has proposed an architecture for the QoS evaluation of Web services. Here the quality of the Web service is evaluated by considering both the measured non-functional parametric values and the assigned weights. For each invocation the non-functional parametric values are measured and stored in the QoS database which will be used by the third party broker to evaluate the actual QoS in comparison with the guaranteed level.

(3) Costing of a Web service based on offered quality

To calculate the optimal cost of the Web service based on the offered quality, the actual metrics are measured and the quality delivered by the provider is recorded in the QoS database. The costing service evaluates the cost of the Web service as per the actual measures and the asserted guarantee in the WSLA. The evaluation system from the third party service will check the deviation from the guaranteed level of quality which has
mentioned in the WSLA that mutually agreed by the signing parties. In this research work, a method is proposed to evaluate the QoS based on functionality and the cost based on the offered quality of the Web services.

(4) Management decisions against service violations for future development

This research work proposes a set of management capabilities to monitor and control the service qualities and service usage. Monitoring management is aimed to rate the behavior of Web services in delivering their functionalities in terms of each QoS parameter. Monitoring Web service behavior is done by assessing QoS parameter values or ensuring to maintain its promised QoS. The costing service of the third party broker will automatically calculate the cost based on the offered quality as per the terms mentioned in the WSLA. This investigation forces the service provider to update the Web service to reach the guaranteed level with immediate efforts and thereby to gain more benefit. The main contribution of this work is to make the customer aware about the quality offering from the service provider and the cost he is paying for that quality. The provider updates the service to meet the changes and challenges in the upcoming IT developments with immediate action. It helps the customer to take a decision to update the service that depends on the business performance. It also alerts both the signing parties of the Web service about the quality deviation from the guaranteed level through active monitoring.

On the basis of satisfying the provider in terms of cost and providing quality for client, an experimental validation, results and analysis of the proposed research work is presented.
1.5 Thesis Organization

Chapter 1 Introduces the problem definition, research questions and thesis contribution in detail. The rest of the thesis is organized as follows:

- **Chapter 2**
  The basic technologies are discussed in this chapter, which consists of individual sections for Service Oriented Architecture (SOA), Web services, Web Service Description Language (WSDL), Simple Object Access Protocol (SOAP), Universal Description Discovery and Interface (UDDI) and Web Service Level Agreement (WSLA). Background knowledge about the Quality of Service (QoS) and related works on QoS management of Web services such as the area of selection, monitoring and management of the Web service were discussed. Also, this chapter presents the literature review in the area of Web service selection, costing and QoS evaluation.

- **Chapter 3**
  The proposed WSLA based monitoring and costing architecture is discussed in this chapter.

- **Chapter 4**
  In this chapter, the attributes that influence the functionality of Web services are analyzed and the corresponding weights are mapped with the non-functional parameters for the assertion of QoS of Web services. The WSLA schema is also proposed for the quality based weight assignment.

- **Chapter 5**
  This chapter describes the technique in which the QoS of the Web services are evaluated. The dataset of continuous invocations for each Web services is considered
to evaluate the QoS. The weights assigned to the non-functional parameters at the
time of selection of the Web service to evaluate the QoS are also discussed in this
chapter.

- **Chapter 6**
  This chapter presents the method for the automatic costing of the Web service based
on the offered QoS. The experimental results of efficiency in calculating the cost of
the service and the optimal correlation between its qualities are explained in this
chapter.

- **Chapter 7**
  This chapter proposes the appropriate methods for the management of Web services if
there are some deviations from the guaranteed level of performance. Also the
necessary decisions to be taken in case of any violations are discussed here.

- **Chapter 8**
  The overall performance of the proposed system and the comparison with the existing
systems are presented in this chapter.

- **Chapter 9**
  The last chapter concludes this research work and provides some future directions
that can be further explored.