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Abstract

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Keywords

Dynamic, supplying, desired, web, service, for, business

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Dynamic Supplying desired Web Service for E-Business

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Abstract—with the number of available web services growing large, supplying the appropriate services for E-business becomes crucial. Dynamic change of customer requirement and available service space challenges the service discovery and selection process. In this paper, we propose a web service dynamic supplying framework, called Web Service Community (WSC), to facilitate invocation of one single service or the composition of several services to complete various business tasks. The prominent features of web service description, discovery and selection in the circumstance of WSC are depicted based on the explanation of the structure of WSC. The desired web services are dynamically discovered and selected by carrying out an efficient service supplying mechanism aimed at maintenance of demand-supply balance on the condition that the utmost satisfaction of customers' requirements is achieved. The invocation process of single service or composition of several services to support E-business is also presented in the paper.

Keywords—component; web service; supplying framework; E-Business

I. INTRODUCTION

With continuous development of service oriented standards and technologies, web services are finding their way into E-business. More and more traditional business functions belonging to an enterprise IT infrastructure are represented as web service, which effectively facilitates interaction and interoperation of diverse application systems within and across organizational boundaries. Customers or applications can access various loosely coupled software functions offered by web services via standard protocols over the web, with no need to worry about the underlying implementation detail. In the near future, buying and using a service over the Internet will become as convenient as buying a product in the real world.

However, analogous to actual business trade, customers also suffer confusion when they need to decide the appropriate one among several web services providing same or similar business functions. The obvious ideological gap between service client and service provider contributes to this crucial issue. Most customer only know what business functions he or she needs and which invocation method is applicable, but has less and even no idea where and how to find the desired web

service. On the other hand, the service providers advertise their services by describing what function and in which condition they can do for customers, without considering who, when and where they invoke the services. Consequently, an efficient approach to facilitate the discovery and selection process is indispensable.

Additionally, the number of services offering a given functionality may be large and the availability and other performance of them may constantly change. Accordingly, we argue that it is not appropriate to decide the most suitable service for the business requirement at design time and advocate that service discovery and selection process should be carried out at runtime.

In this paper, we present a web service supplying approach to support business applications by dynamically discovering and selecting the most suitable service to meet customer's requirement. The salient features of our approach are:

- *A web service dynamic supplying framework.* We propose *Web Service Community* as an extensible web service supplying framework to facilitate reliable implementation of one web service or the composition of several web services for business application. The goal of this web service supplying framework is to gain a demand-supply balance between customer's requirement and available web service space on the condition that all requirements are utmost satisfied.
- *Customer-preference driven service selection.* A reciprocal constraint mechanism is proposed in the circumstance of web service community. Trustworthy feedbacks are collected and used to rank participants, including both service providers and service requesters.
- *Actively supporting E-business application.* Our web service supplying approach not only simply find the needed services for customers but also identify the excellent individual service in terms of a given business functionality.

The remainder paper is organized as follows. Challenge and related work are discussed in section II. In the next section, we introduce the structure of Web Service Community (hereafter

WSC) and interpret description, discovery and selection of web service in the circumstance of WSC. In section IV how to supply web service, both single and composite, are explained. In next section, the test application designed to validate the feasibility and study the efficiency is given. Finally, section VI draws conclusion and discusses the future work.

II. CHALLENGE AND RELATED WORK

The basic service oriented architecture [1] describes the relationship of three typical roles, respectively service provider, service client and service registry, as well as defines an interaction between software agents as an exchange of messages between service requesters and service providers. However, this basic architecture is proved insufficient in following conditions: 1) discover and select the appropriate one from several web services offering same or similar functionality with different performance; 2) has less idea to exploit nonfunctional properties which always influence a customer's decision in web service discovery and selection process. Accordingly, the basic architecture is unable to support automatic discovery and selection process among various potential services [2].

How to describe a web service in terms of both its function capacity and nonfunctional attributes is one of key points to handle above problems. Meanwhile, the automatic implementation of web service-enabled e-business [3] requires distinct specification of web service detailed aspects concerning meta-level data for services and its operations, transport bindings, technical contract/agreement, etc. Generally, web service is described using XML-based Web Services Description Language (WSDL) [4]. However, WSDL description is purely syntactic and inherently is impotent to express the underlying semantic meaning of WSDL document.

Semantic of web service description means great to service discovery and selection process because these semantic information help customer to understand what is exactly function offered by a service. Furthermore, there is no way to cooperate if business partners use different terms for the description of interaction style and related exchanged message formats [5]. As a result, the technologies available in the field of semantic web are introduced into research on web service during exploiting semantic web service. Ontology provides us the ability to reuse knowledge across the web by sharing the same interpretation of the related terms. Nevertheless, most process based on ontological description and reasoning is time and resource consuming.

Additionally, two services might offer quite different functions although they share same parameters and data formant of inputs and outputs. Consequently, OWL-S [6] is introduced as extension of the Web Service description based on such an assumption: service requires some input to perform it and generates some outputs as a result only when some preconditions are satisfied and some effects emerge after the service execution, namely IOPE. Our previous work improves the capability matching based on OWL-S description by adding some constraints [7].

Currently, some research work has been done on web service discovery and selection. First, quality of service is one

of most popular factors influencing the service selection. A global planning approach [8] is proposed to optimize service selection using efficient linear programming methods, considering multiple criteria, global constraints and preference set of the client. Second, similarity between different services attracts many researchers' attentions. A similarity search primitive is proposed to implement searching for web service operations by exploiting the structure of the web service description based on WSDL and grouping parameter names into some meaningful concepts [9]. Last but not least, the client personalization is definitive complication we should take into account during selecting the adequate service. A web service personalized selection approach [10] divides the user profile to three different parts and features an expansion of the service request by user specific demands and wishes to support diverse steps of interaction with services.

It should be mentioned that implementation of various E-business applications supported by invocation of several web services means not only efficient discovery and selection process of web services. A web service promotion model [11] defines a management network including three types of IT resource to support partnership establishment, resource exchange and service provisioning to enhance QoS. Accidentally, a same name, *Web Service Community*, shares with our web service supplying framework, although they are really different thing.

The distinct difference between our approach and others lies in that dynamic change of business requirement and available web service space are considered during designing and implementing of our web service supplying framework. Additionally, an efficient mechanism is implemented in Web Service Community we propose, aiming at obtaining and maintaining a demand-supply balance on precondition that utmost satisfaction of customers' requirements are achieved.

III. WEB SERVICE COMMUNITY

We depict Web Service Community as such a specific union where diverse business processes are interacted and collaborated on the basis of invocation of various web services offered by different service providers.

A. Structure of Web Service Community

In a nutshell, the structure of WSC can be formalized as follows: $WSC ::= \langle PI, BP, WR \rangle$. Here,

- *PI* (Participant Identify) refers to unique identifier of valid participants in WSC, including customers, service providers and managers. Sometimes an overlap exists among three characters.
- *BP* (Business Process) denotes the definition of various business process implemented in the circumstance of WSC.
- *WR* (Web Resource) signifies those required resource supporting the implementation of various business process, including data resource (descriptive type), service resource (functional type) and connection resource (interconnectivity type).

Furthermore, the novel structure and organization model of web services pushes WSC distinctive from other framework. All services registered in WSC are clustered into one or more than one *subject-club*, one fundamental ingredient of WSC. Subject-club is something like a special service container in which services located in different places but with similar domain function are grouped. Acting as a functional logic sorter, subject-club plays an important role in web service discovery and selection process.

Formally, subject-club is defined as follow: $SC ::= \langle BusinessSubject, WebServiceSet, ClientSet \rangle$. Here, *BusinessSubject* describes the abstract concept involved in the description of business function which could be offered by all member web services and in the meanwhile *WebServiceSet* and *ClientSet* respectively refer to the set of member web services and those customers who show interested in the business subject of a given subject-club. It should be mentioned that the actual business requirements decide the subject definition of all subject-clubs in the circumstance of WSC. Additionally, the granularity of discovery, selection and management in the circumstance of WSC are all based on the subject-club.

B. Web Service Description in Web Service Community

Efficient web service description should exactly explain what problem the service can solve, namely service capability. Generally, service capability is represented in implicit and explicit way [12]. The explicit description presents web service by enumerating the tasks it performs, while the implicit description depicts the transformations it produces on its environment during service execution.

Description approach is another distinctive feature of Web Service Community. Web service description in the circumstance of WSC combines concordantly explicit representation and implicit representation, taking both commonness and peculiarity of individual service into account.

In the circumstance of WSC, those services providing same or similar functions are cluster into a specific subject-club. Accordingly, service description in WSC is stored and retrieved at three layers: subject-club, OWL-S and WSDL, respectively depicting function abstract, capability and provider representation of web service, displayed in fig. 1.

Figure 1. Web service description layers in WSC

Web service is described in both syntactic and semantic way in WSC. The hierarchical community ontology, illustrated in fig. 2, is built as a “template” for description of semantic knowledge of diverse resources and management strategies. Especially, subject-club ontology consists of club local ontology and web service private ontology, respectively corresponding to commonness and peculiarity of web services.

Figure 2. Structure of community ontology

The description approach in WSC naturally indicates the relationship between business requirement and available web service space, which is associated with subject concept and web service distribution in subject-clubs. Accordingly, the development of diverse subject-clubs make web service discovery, selection and supplying process sensitive and active to changes at business level and in service space.

C. Web Service Discovery and Selection in Web Service Community

Broadly speaking, in the circumstance of WSC the service discovery and selection process could be summarized as finding potential subject-clubs and selecting the most suitable service within subject-clubs picked in the first step. Discovery of advisable subject-clubs improves the efficiency and flexibility of service selection process by shrinking search space of potential services.

Another important ingredient of subject-club, *leading service list*, has an influential impact on service selection process within a certain subject-club. Leading service list, derived from corresponding club local ontology, presents some significant recommendations by enumerating best service in light of some popular nonfunctional properties cared by most customers focusing on a given business functionality. In addition, leading service list is such a dynamic table, stored in history database maintained globally and continually updated after a definite time interval.

Furthermore, one subject-club in WSC can contain more than one leading service lists and each leading service list can be formalized as $LSL ::= \langle KeyProperty, ServiceIdentifier, ServiceURL, AssessmentValue, Rank \rangle$. Here, the meaning of *KeyProperty*, *ServiceIdentifier* and *ServiceURL* is implied by its name. *AssessmentValue* and *Rank* indicate respectively the score and grade of performance of web services involved in certain leading service list, estimated according to a specific *KeyProperty*.

As displayed in fig. 3, web service discovery and selection process in the circumstance of WSC is implemented in terms of the layer structure of web service description. Accordingly, the

detailed operations of matching engine in WSC consist of three components: subject-club matching, OWL-S matching, and WSDL matching, which are responsible for finding the potential subject-clubs, selection of most appropriate service at semantic and syntactic level. The algorithm of matching based on OWL-S is proposed in [7].

Figure 3. Discovery and selection process in WSC

As for a given business functionality, leading service list closely links the actual customer preference and available web services with excellent performance in terms of some popular and key properties. After every execution of member service of a subject-club, the superiority of the web service involved in related leading service list is verified by comparing feedback data from the monitor with original data of the leading service list. The selection algorithm of best service is detailed in our previous work [13].

IV. WEB SERVICE SUPPLY IN WEB SERVICE COMMUNITY

In the circumstance of WSC, web service is treated as a functional type of IT resource. How to allow authorized customers to access their required services and in the meantime, the usage of various web services can obtain and maintain an acceptable demand-supply balance challenge the task of supplying web services for E-business. In order to accomplish this goal, one service supplying mechanism is brought into effect, which consists of following parts:

- *Selecting required web service at runtime.* Because of the variety and dynamic nature of available web service space, determination of the appropriate web service for the customer requirement at design time is not an optimal approach.
- *Discriminating requesters for web service access in terms of the priority.* The priority of customer and web service indicate respectively the customer ability of assessing excellent web services and the service's opportunity of responding customers' requesters. The

priority is not constant and could be modified in some predefined conditions.

The first mechanism guarantees that customers can utmost take advantage of available services within limitation. The second one facilitates the demand-supply balance by controlling customers' access to excellent web services. The value of priority would be modified when one of following things has happened:

1) Increasing the priority:

a) *customer:* the customer has done some contribution to the development of WSC, or some reward regulation refers to the customer.

b) *web service:* the service has been proved an better performance than other service offering same or similar function and meanwhile its payload is enough.

2) decreasing the priority:

a) *customer:* punishment has been done to the customer because of some misfeasances.

b) *service:* the payload of the service is in critical condition although it can offer excellent function or some punishment has been done to it.

The service-enabled E-business applications could be completed by invoking one single service or the composition of several services. Firstly, we discuss the process of supplying one web service for E-business, displayed in fig. 4. Some analysis, translation and extraction have been carried out to get matching data from the customer requirement description. The monitor host by the reliable third party is responsible for monitoring the selected web service execution and collecting feedback used for update of related leading service list.

Figure 4. Supplying single service for business

On the other hand, if one single web service can not cover all required business functions, the composition of several web services is necessary. Generally, the business process is defined as a set of interrelated tasks linked to some activities performing logical steps. Consequently, as displayed in fig. 5, the selection broker select several appropriate services to offer required business functions strictly abiding the web service schedule generated from the process scenario. Selection

process of every component service is analogous to the process of supplying one single service.

Figure 5. Supplying the composite web service for business

It should be mentioned that the leading service list facilitates actively supplying the web service with the best performance within available service space to meet a specific business functional requirement.

V. TEST APPLICATION

In order to validate the feasibility and study the efficiency of supplying service for E-business in WSC we proposed, we develop and implement a B2C application in the case of travel arrangement, called *TravelAgent*. There are two subject-clubs developed for the implementation of *TravelAgent*, whose subjects are respectively *Flight* and *Hotel*. In other words, the two subject-clubs contain those services offering functions of booking flight and arranging hotel for travelers. The subject-club *Flight* includes two leading service lists, indexed by *cost* and *destination* and the other subject-club *Hotel* contains three leading service lists, indexed by *location*, *cost* and *location&ranking*.

We test our service supplying framework and dynamic discovering and selecting algorithm by simulating two occasions: 1) replacement of the original service with another one: the original airline service cannot provide appropriate flight for customer's new schedule; 2) different customer preference drives discovery and selection process different: one customer desires the cheapest cost amount and the other one propose the special requirement on hotel location and ranking. Experiments have proved that our supplying framework and selection algorithm can efficiently support the dynamic supplying with an acceptable satisfactory.

VI. CONCLUSION AND FUTURE WORK

Based on existing Internet protocol and open service oriented standards, web services can provide a flexible solution for E-business application to implement business logic functionality without considering underlying technical detail of several partner organizations. Active web service supply for E-business by dynamically discovering and selecting the appropriate component services become an important issue.

In the paper, we propose a web service supplying framework, called Web Service Community (WSC), to facilitate web service description, discovery, and selection at semantic level. In the circumstance of WSC, services are clustered in terms of semantic similarity of capability and the recommendation is offered for service selection process according to customers' preference. At the same time, a service supplying mechanism is carried out to constraint the supplying process through invocation of one service or the composition of several services, aimed at maintenance demand-supply balance on condition that most customers' requirements are satisfied.

Our ongoing research includes optimization of web service clustering distribution by finding more reasonable granularity of subject-club in WSC. At the same time, we will explore the service dynamic supplying process to cater for the change of business workflow.

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