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Dynamic Composition of Web Service Based on Cloud Computing

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Abstract

Traditional web service discovery composition technology is hard to get adapted to dynamic, flexible modern business workflow. Due to the advantage of Cloud computing, dynamic, distributed, heterogeneous and autonomous nature to solve this problem provides a new way of thinking. This paper proposes a cloud computing environment that supports dynamic application service composition model, and in order to meet the real dynamic workflow environment, proposed cloud computing Web Service workflow management system CCB_WSFMS.

Key words: *cloud computing; web service; service composition; workflow*

1. Introduction

With the development of new internet technologies, available on the internet web services the number is growing big, Among these services, there are many similar functions or grammatical similar services ,the existence of these web services, according to the needs of users in different situations, it responses to the different needs, different business processes, Then you need to put basic services [1] or sub-processes to a certain logic combinations and make them dynamically between these services and service interactions in order to achieve user-specific business processes, we discovery and select, compose and meet QoS [2] in many of web services, and a group of web services are most satisfied for users. It has become a new hotspot for web service composition, especially for those the same function, different non-functional characteristics of services, the quality of service composition by the common concern of academia and industry. Traditional RDF triples semantic reasoning and query speed is very slow, it cannot meet the rapid and changing modern business processes. In recent years, with the development of cloud computing technology, it provides a new way to solve this problem, due to the dynamic nature of cloud computing, distributed, heterogeneous and autonomous nature of these advantages, on this basis the web service composition is more flexible, efficient, and convenient.

This paper proposes a cloud computing environment that supports dynamic application service composition model, and in order to satisfy the real dynamic workflow reality environment, proposed cloud computing Web service workflow management system CCB_WSFMS Cloud Computing-Based Web Service Workflow Management System).

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2. Related Background Knowledge

2.1. Web Service

Web Service from the functional perspective is an Internet-facing self-description, self-contained basic building blocks of distributed computing, with a cross-platform, cross-language, loosely coupled, distributed transparency and other characteristics [3]. The basic Web services architecture contains three roles and three basic operations; it also contains many other protocols, such as UDDI, WSDL, SOAP, WS-Security, *etc.* Three roles: service users, service providers, service register center. Service users are an application program, a software module or another service to a service. It is through the registry service to query, by binding service, and execution services, Service provider is an entity that acceptance and implementation of the service from the service requestor requests, Service discovery service registry is the place that contains a repository of available services and allow service requesters interested lookup service provider interface. Three kinds of operations: publishing, discovery, binding and invocation. Web services conceptual model shown in Figure 1.

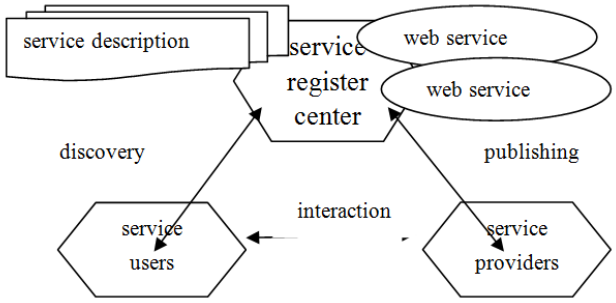

Figure 1. Web services conceptual model

Traditional Services Description Language WSDL [4] has been unable to truly express a service function, because WSDL has only pure grammar rules, the lack of semantic recognition, and now Web services are based on the ontology-based OWL-S [5] and WSMO [6] to better describe the service, so that these services have the semantic features, so that it can describe a web service, in order to discovery service and reason better express service requester's meant to increase the efficiency of service discovery and service matching the probability of success.

Definition 1. Service

A service can use to represent a quintuple :S={SN,DS,I,O,OP},SN represents the service's name, DS represents the service's description, I it means input set, O for output set, OP indicates that the service operation. We said that DS includes functional information services and non-functional information, functional information for example travel services provide man or woman to travel another places and relax. non-functional information for example total prices, car service kind and so on .above $I=\{i_1,i_2,i_3,i_4,.....,i_n\}$,$O=\{o_1,o_2,o_3,o_4,.....,o_n\}$.$i_i$($i\geq 1$and $i\leq n$) represents input sequence, o_i($i\geq 1$and $i\leq n$) represents output sequence.

Definition 2. Service Request

A service request can be used quad: SR = {I, O, QoS, M}, where QoS for the service requester non-functional overall service (QoS) requirements, such as response time, reliability, availability, security, *etc*... M represents a service matching degree, we refer Paolucci [7], who proposed a matching algorithm based on the input and output, and there are four kinds of matches:

Exact match: services provided complete cooperation with the requested service agreement.

Embed match: services provided to complete the requested service than more features.

Contain match: the service can only provide part of the service to complete the requested function, but not fully realized the requester's goal.

Failed match: service provider cannot find the desired functionality.

2.2. Cloud Computing

Cloud Computing is put forward in 2007, is based on grid computing, parallel computing and utility computing developed, it is the commercial implementations, the world famous science and technology companies have joined the ranks, such as Google, Microsoft, Amazon. These companies are developing their own cloud computing products in their own way with their own understanding. But about the definition of cloud computing version is very much, until now there is no generally accepted definition. Here are two typical.

Berkeley [8] on the definition of cloud computing: cloud computing refers to the service mode applications published through the internet as well as data center hardware and software resources required for these services.

Luis M. Vaquero [9] proposed cloud computing is an easy to be used and accessible pools of virtualized resources, these resources can be dynamically reconfigured to adapt to varying system load, taking optimal resource utilization.

From above two definitions, we can see that cloud computing has the following features: virtualization, high availability, on-demand services, rapid elasticity, measurable service, *etc*., in these advantages, the biggest advantage is readily available on-demand computing services according to pay [10], the user dynamically apply or release resources according to dynamic business processes, to achieve the speed and efficiency of service composition the best balance. According to different cloud computing have a different understanding of law, in accordance with the different levels of virtualization, cloud computing has three service models: Software as a Service (SaaS), the service provider will be packaged into a specific application software services on cloud infrastructure memorial consumption to use, such as Saleforce company's online customer relationship management CRM; platform as a Service (PaaS), service providers will provide programming languages and programming tools on this platform, consumers can develop their own applications, such as Google App Engine; infrastructure service (IaaS), service providers will hardware devices such as computing resources, storage resources, network resources, packaged as services for consumer use, such as Amazon's EC2.

2.3 Cloud Workflow

Workflow technology in the 1980s, when people want to have a paperless office environment, resulting in a number of representative products, such as IBM's Flow Mark, Lotus Notes and more. According to the definition of the Workflow Management Coalition

[11], workflow is in accordance with certain pre-defined rules, which documents, information or tasks can be passed between different actors in the implementation, in order to achieve all or part of the business process automation execution. As workflow technology in the information integration huge advantage, so it is in the modern enterprise business processes, or in scientific research, workflow is has become an indispensable tool. Currently workflow management both in e-commerce, e-government is still in have been more widely used, the emergence of cloud computing environment, the workflow system architecture, operating platforms and so had an important and far-reaching impact. Traditional workflow as are business-oriented grid workflow applications in the Internet environment, the traditional workflow is no longer suitable for the needs of the modern enterprise, especially the traditional workflow for sudden load quality of service, such as: food ordering system, it may be in a certain time period (for example: 7:00 ~ 8:00), the system is running the required memory resources, CPU resources, network bandwidth resources is relatively large, while in other time periods, that is, when the burst loads in the past, when the resources required is relatively small, according to the resource requirements of unexpected load to the procurement of resources, will result in a waste of resources, as well as operation of the environmental pollution. The emergence of cloud computing environment, to solve the above problem provides a possible workflow and how to combine cloud computing, and workflow in the cloud computing environment dynamically adjust resources, service users is to minimize the cost obtain service goals,cloud workflow came into being. Cloud workflow is a cloud computing environment workflow technology to cloud computing environment platform development and deployment of modern business away, including business process dynamic modeling; support the monitoring of computing resources, implementation, resource dynamic deployment and process safety management. Workflow Management System cloud computing environment in a variety of virtual resources effectively organized to ensure that business processes in these virtual resource efficient and effective and orderly operation, and is transparent to the user, resources are highly available, resilient.

3 Dynamic Composition of Web Services Scenario Analysis

In a complete business process, dynamic service selection, dynamic combination in the actual process is very complex; services are usually chosen according to the different needs of users. Here give a typical example, in order to better illustrate the dynamic Web services composition. We have a common travel services, for example, in the travel services are generally divided into three case: with travel, self-driving, half travel agencies, on an individual or group who will be according to their actual situation to choose a different way to travel, from the perspective of tourism services, will involve several aspects, ticketing, travel, hotels, attractions, restaurants, and guides ,specifically related to the services booking service, car services, hotel services, scenic spot services, catering services, guide service. Travel services in Figure 2.

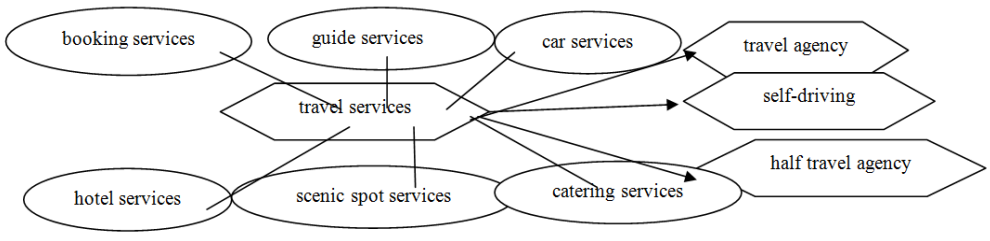

Figure 2. Travel services

In Figure 2 travel mode refers to all the services are performed by providing services to travel agents, tourists do not care involves services that are transparent for tourists, traveling by car outside services are in addition to attractions by the tourists themselves to be responsible, while the semi-travel booking services and travel services are provided by tourists responsible for their own, the other by a local travel agency to perform from the point of view of three ways to travel, this process analysis, Attractions service is the core of every way to travel must be attending a service in the travel services directed acyclic graph (DAG) in a certain activity (service), and is a necessary activity, it must be executed, while the remaining service business processes based on different travel modes (select different branches) and some rounding off, the service is dynamically selected combination. Travel services flow chart in Figure 3. The solid line in Figure 3 indicates that must be performed, dashed line selected for execution.

In this example, we do not refine each service, such as ticket service, ticket service can be a network, and it can be telephone booking services. From this example we can see that as a service provider, only in determining the service process before it can invoke specific services, more specifically, to meet the service requestor, to spend the minimum cost of the service portfolio, the user is the most satisfactory.

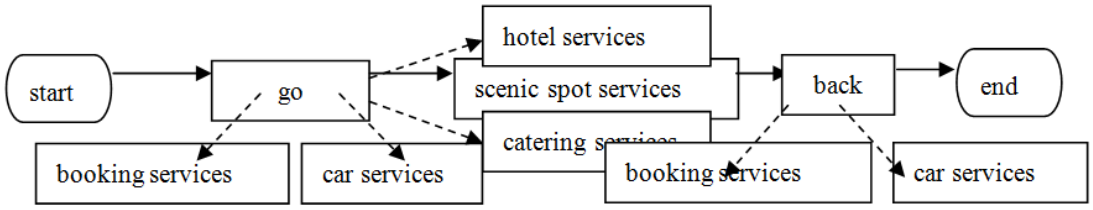

Figure 3. Travel services workflow

4. Cloud computing architecture for Web service composition

Workflow Coalition (WFMC) reference model in the cloud computing environment, the Web service composition provides a good idea, we propose a cloud computing Web service workflow management system CCB_WSFMS (Cloud Computing-Based Web Service Workflow Management System). The main advantage of the system monitoring module (Monitor Unit) real-time monitoring system quality and service quality information, resources, once the system reaches a certain red value, the system automatically enables resource adjustment module, choose less costly and the resources to meet user needs, to achieve customer expectations objectives.Mainly contains the following modules, Process Unit, Monitor Unit, Model Unit, Discovery Unit, Compose Unit (Race Module, Match Module, Order Module). CCB_WSFMS architecture shown in Figure 4.

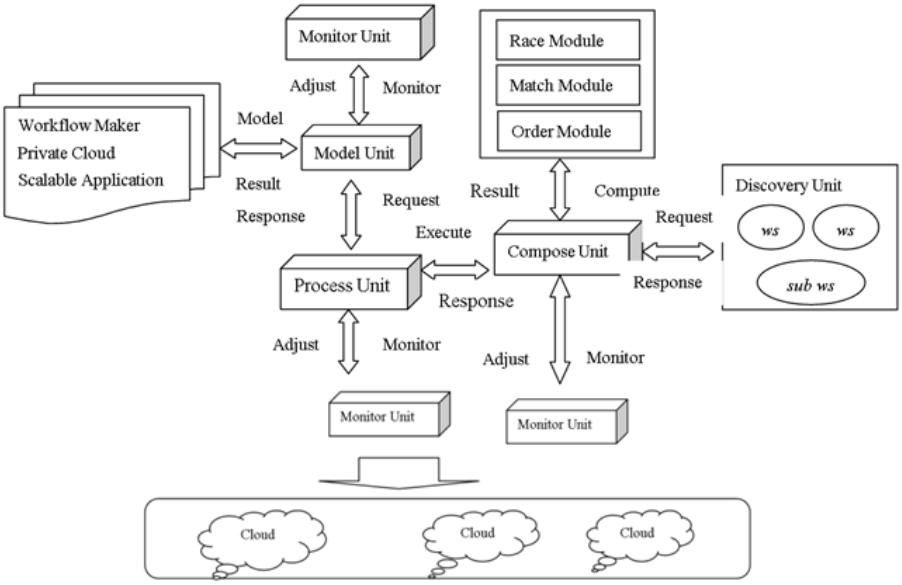

Figure 4. CCB_WSFMS Architecture

In Figure 4, the cloud work shed Web service composition is based on the cloud computing platform, the Process Unit, Model Unit, Discovery Unit, Compose Unit, has run its Monitor Unit Monitor , dynamically adjust resources, Described here is to dynamically adjust resources, that is adaptively adjusted, which requires monitoring unit dynamically collect performance parameters, when the load suddenly increases, the system response is too slow, the user experience is bad, high system resource utilization time, then you need to increase the computing resources, the same time when the load decreases, the system response and recovery to a reasonable level, system resource utilization is not high, cloud resource management module release just applied for a temporary resource.

Resources adaptive workflow system is cloud computing one of the core functions; his goal is to demand in a timely manner to increase computing resources, timely release of resources. How to determine the current system is to increase the resources or the release of resources is to see the current system running load conditions, the workflow engine dynamic resource configuration shown in Figure 5.

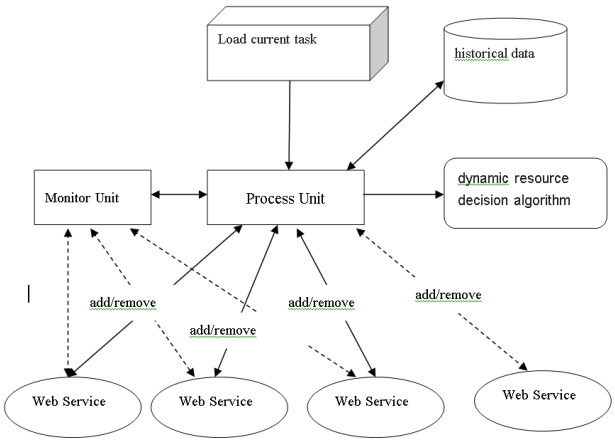

Figure 5. Workflow engine dynamic resource configuration

In Figure 5, the dynamic resource decision algorithm for cloud workflow system automatically provides the service node to add, delete mechanism decision algorithm with dynamic resource monitoring unit, the real-time performance data in real-time feedback to the execution unit, time to increase a service node, or delete a service node. Meanwhile, in order to improve the efficiency of execution, we took early intervention approach, *i.e.*, an increase of historical data, through the analysis of historical data and the current system load, call the resource can be better.

Dynamic Resource decision algorithm workflow shown in Figure 6.

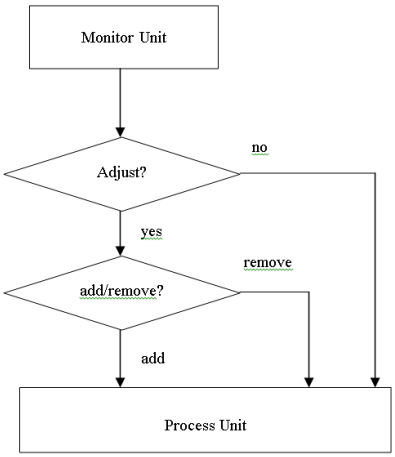

Figure 6. Dynamic Resource decision algorithm

Process Unit: is CCB_WSFMS the core, he is responsible for the process instance creation, execution, operational control, return the last execution result to the service caller.

Compose Unit: is a combination of service units, according to the Discovery Unit found that syntax, semantics similar services portfolio, which includes inference engine module, matching module , sorting module, which is the inference engine module according to the business process and satisfy QoS requirements, identify and locate the corresponding service; matching module is found doing semantically related services, such as WS_i is WS_{i+1} precursor services, WS_i at execution time must be given priority in WSi+1 execution, or WS_i and WSi+1 parallel service, WS_i / / WSi+1, their execution order no order; sorting module is returned multiple results, in accordance with QoS select the best combination of service, return to the caller.

Model Unit: a modeling unit, the user's initial modeling business processes, and during the execution of the service, to dynamically adjust the model shape, to further meet the needs of users.

Discovery Unit: primarily responsible for semantic service registry found matching service, had expressed earlier web services are now using OWL-S to describe, more accurately semantically rather than from the linguistic expression of a Web service function.

Cloud: mainly includes user management, resource management, task management, virtual machine management, access control, security management, resource management for the physical layer, users can access resources on Web Services interfaces, access to resources. This layer of the entire cloud computing resources is transported workflow system based,

which makes the workflow system's ability to deal with things that cloud computing can support massive computing.

The entire framework works as follows:

1) user functional requirements will be submitted to the Model Unit, its use of modeling tools based on functional requirements define the workflow process, and returns the results to the workflow engine execution units.

2) workflow engine execution unit processes parser based on their workflow process definition file, the resulting information transmission combination unit.

3) combination unit according to target information to find the Discovery Unit meet functional requirements to meet the QoS of Web Service, through its input parameters bound calls, while bound to a single Web service, reasoning, matching, and multiple combinations sort results, select the higher cost of services portfolio, returned to the workflow engine execution units.

4) workflow engine execution unit to receive specific workflow model information, according to the model defined in the control flow and data flow information, orderly implementation of the individual Web services in a cloud environment that is called cloud computing Web service, which will need parameters passed through the interface to Cloud.

We have a unified digital campus service platform, for example, through the Java language experiment compared the traditional Web service composition and cloud computing services composition method, the experimental parameters in three main areas to illustrate that the number of requests, response time , resource utilization, we set the number of service requests is 100. The results are shown in Table 1.

Table 1. The traditional Web service composition and cloud computing services composition method comparison table

	Request num	Response time	resource utilization (CPU)
Traditional method	100	125ms	12%
Cloud Computing	100	81ms	83%

5. Conclusion

Based on the current research focus of cloud computing analysis, combined with existing web service composition technique, these two techniques combined to form a cloud-based Web service composition study research, the cloud computing web service workflow management system CCB_WSFMS system structure, And analyzed CCB_WSFMS architecture and working process, a good solution in the Internet under workflow system performs dynamic demands for resources, While the use of dynamic resource decision-making algorithms, dynamic adjustment of resources, so as to achieve the purpose of saving resource use.

References

[1] B. Benatallah, M. Dumas, Q. Z. Sheng and A. H. H. Ngu, "Declarative composition and peer-to-peer provisioning of dynamic services", Proc. of the 18th Int'l Conf. on Data Engineering, San Jose: IEEE Computer Society, (**2002**), pp. 297~308.
[2] L. Z. Zeng, B. Benatallah, A. H. H. Ngu, M. Dumas, J. Kalagnanam and H. Chang, "QoS-Aware Middleware for Web Services Composition", IEEE Transaction Software Engineer, vol. 30, no. 5, (**2004**), pp. 311–327.

[3] M. E. Papasoglou, "Service-oriented computing; concepts, characteristics and directions", Proceedings of the Fourth International Conference on Web Information Systems Engineering. Roma, Ita1y; IEEE, (**2003**), pp. 3-12.
[4] http://www.w3.org/TR/wsdl.
[5] http://www.w3.org/Submission/OWL-S/.
[6] http://www.wsmo.org/.
[7] M. Paolucci, T. Kawamura, T. Payne, *et al.*, "Semantic matching of web services capabilities", The Proceedings of The First International Semantic Web Conference (ISWC), Sardinia (Italy), (**2002**).
[8] M. Armbrust, A. Fox, R. Griffith, A. Joseph, R.Katz, A. Konwinski, G. Lee, D. Patterson, A. Rabkin and I. Stoica, "Above the clouds: A Berkeley view of cloud computing", EECS Department, University of California, Berkeley, Tech. Rep. UCB/EECS-2009-28, (**2009**).
[9] L. M. Vaquero, L. Rodero -Merino, J. Caceres and M. Linder, "A break in the clouds: Towards a cloud definition", ACM SIGCOMM Computer Communication Review, vol. 39, no. 1, (**2008**), pp. 50-55.
[10] I. Foster, Z. Yong, I. Raicu and S. Lu, "Cloud computing and grid computing 360-degree compared", Grid Computing Environments Workshop 2008, GCE'08, (**2008**), pp. 1-10.
[11] TC00-1003-1995, The Workflow Reference Model, Workflow Management Coalition, **(1995)**.

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