DOI: 10.7763/IPEDR. 2012. V49. 27

Research and Design Application Platform of Service Grid Based on WSRF

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Abstract. To provide an effective solution for kinds of application sharing and cooperation in enterprise, the author brings forward Application Platform of Service Grid (SGAP) based on WSRF by analyzing the Open Grid Services Architecture and Web Services Resource Framework. According to the characteristics and application of service grid, this dissertation adopts the method which makes all the resources encapsulated as service, models the resources according to the norm of WSRF, and builds the Architecture of SGAP. Finally, this dissertation gives the service encapsulation general method. Considering that there are a lot of legacy systems, this dissertation designs the service encapsulation middleware. The middleware can encapsulate the EJB and C applications to service that can be shared and used under the platform, which solves the resource sharing problem in enterprise and adapts to the need in the development of the enterprise business.

Keywords: SGAP; WSRF; Service Grid; Service Encapsulation

1. Introduction

Grid technology is an emerging technology which builds on the Internet. It makes the Internet to a new stage. It can make users share the resource in virtual organizations and access the resource of other by security authentication. By building a grid system, distributed resources (data, computing ability, storage ability) can be furthest used. The users can put the decentralized functions together, and integrate all kinds of the companies' application systems, created as a single logical system, and finally implement the virtual sharing, management and access by crossing enterprise, industry, and lonely islet of the resources will be eliminated and the resources will be shared. When the grid was just brought forward, the concept of grid only limit in the field of scientific computing, the question it cared is how to make many resources in grid environment, for example data, computing ability, storage medium and so on, integrate a computing environment of seamless integration. However, with the developing of gird researching, many commercial companies have observed the innovative potential and powerful functions brought by the grid technology, and also have realized that the grid technology can serve as a kind of developing framework of IT to improve the business platform. The emergence of grid concept brings a new way for Enterprise Flexible Composition Services (EFCS) system based on web Service. To support the business services based on Web Service, IBM puts a concept of Service Grid forward. The concept describes Sharing and integration of Grid Service, which is service domain-oriented, and provides an extensive scope for the applications of web Service.

Service Grid is a dynamic combination via the abstract description, organizing, management and service of the Service Resource, and supporting the application of Virtual Organization in the opening environment, and flexible and efficient sharing resource on Virtual Organization and implementing the business-class cooperation. What it cares is that how to build and organize the business class service of big particle degree, how to let the business end user assemble the Service-Oriented Business Application of meeting demand, thus ,it can build the network application better and more quickly, which personalized, adapt business changes and meet the real-time requirement [1,2].

To the questions mentioned, the author brings forward Application Platform of Service Grid Based on WSRF by analyzing the Open Grid Services Architecture [3], and Web Services Resource Framework [4].Under the platform, the article implements the operation that makes some components that are in Legacy System, such as EJB, C application program and so on, encapsulate a service that can be shared under the platform. SGAP solves the shared services problems in Service Grid, making the service in platform can be

used by the authorized users expediently. Furthermore, based on the service encapsulation middleware of the platform, it solves the software resource sharing problem of Legacy System in enterprise, and then makes use of the plenty resources in enterprise effectively.

2. Technology Related

2.1 Open Grid Services Architecture (OGSA)

At the present stage, there are three more important grid architectures. The first one is that Ian Foster etc. have brought forward the five layers hourglass architecture earlier. The second one is that under the influence of IBM, the representative of industry, and considering the developing and influence of Web technology, Ian Foster etc. bring forward the Open Grid Services Architecture[3,5] combining the five layers hourglass architecture with Web Service. The third one is the WSRF which is brought forward together by Globus Association, IBM and HP in early 2004 [4].

OGSA is the Service-oriented Architecture, focusing on "Services" is its most prominent thought. It introduces the Web Service interoperable model into the grid research, establishing the Web Service as grid resources' new abstract form and structural basis. Any component of grid, such as the grid storage resources and computing resources and so on, is all service. In the environment of grid application, a large amount of service is temporality and momentary, for example, an execution of a computing task. Considering this feature, OGSA brings forward a new concept, "Grid Service", based on the concept of Web Service, used to solve the Service Discovery, Dynamic Service Creating, Service Lifecycle Management problems which concerned with temporary service. Based on the concept of grid service, OGSA regards the whole grid as "Grid Service" set, but the set is not stable, it can expand.

The architecture of OGSA is shown in Figure 1. The four layers of OGSA are respectively resource Layer, Web Service Layer, Grid Service Layer and Application Layer from down to up [3].

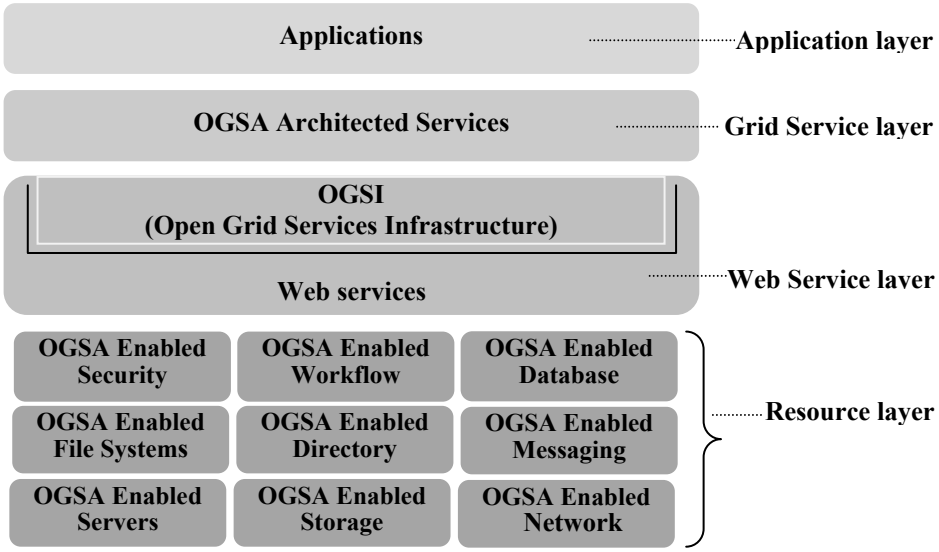

Fig. 1. The structure of Open Grid Services Architecture

- Resource Layer: Located at the bottom of OGSA, in this layer, server, storage devices and networks are all regarded as physical resource. Logical resources are close to physical resources on its top. It is usually a group of middle ware application set, including Database, File System, Workflow Manager and so on.
- Web Service Layer: In this layer, all of resources (including physical resources and logical resources) are abstracted as services. This layer provides a solid foundation for supporting service.
- Grid Service Layer: In this layer, we can find data extraction, program execution, monitoring and some other core services.
- Application Layer: this layer is made up of the application program based on OGSA.

2.2 Web Service Resource Framework (WSRF)

The core architecture layer of OGSA is Open Grid Services Infrastructure (OGSI) and OGSA Architected services. OGSI shows a defect in the application process. The norm of OGSI overemphasizes the difference between Grid Service and Web Service, and it doesn't distinguish between resource and service, resulting in a consequence that the two cannot fuse better together. OGSI makes the stateful resources model of Web Service through the status of encapsulation resources, but it and the statelessness of Web Service come into conflict, at the same time, most of realized Web Service can not finish the demand that dynamic create and destroy service in grid. WSRF has the completely different definition with Grid Service, it rules that resource is stateful, while service is stateless, WSRF separates the Web Service and stateful resource, and brings forward a concept of Web Service Resource, solves the contradiction between OGSI and Web Service effectively.

The norm of WSRF is defined in comparison OGSI's main interface and operation, it reserves all the basic functions which is ruled by OGSI, only changes some syntax, and expresses by different terms. WSRF makes Web Service Architecture change in two sides: one is that it provides the transmission neutral mechanism to position Web Service; and the other one is that it provides information mechanism set which can obtain the released service. The specific information contains WSDL Description, XML Schema Definition and the necessary information of using the service.

- Web Service Resource Framework defines a series of norms in using Web Service to access stateful resource. It includes the norms of WS-Resource Lifetime, WS-Renewable References, WS-Resource Attribute, WS-service Group and WS-Base Faults.
- Compared with the original core norm of OGSA, OGSI, WSRF has three advantages [4]:
- WSRF blends in the Web Service standard, and more fully expanded the existing XML standards. In the present development environment, making it realize more easily.
- The Factory interfaces in OGSI provide less available functions, but in WSRF, they define more common WS-Resource Factory schema.
- The notification interface in OGSI norm neither provides the required functions in Event System, nor provides kinds of functions that exist now supported by middleware of message-oriented. While the norms in WSRF make up the above shortages.
- To WSRF itself, the norms need further application proving in practice, and gradually improved. The service grid platform based on OGSA and WSRF and standardized protocol, it will finally become the infrastructure of Next Generation Internet, and all of the application will implement on grid foundation platform. The Implementation Framework of Service Grid which is brought forward in this article is built on WSRF of OGSA.

3. The Architecture of SGAP based on WSRF

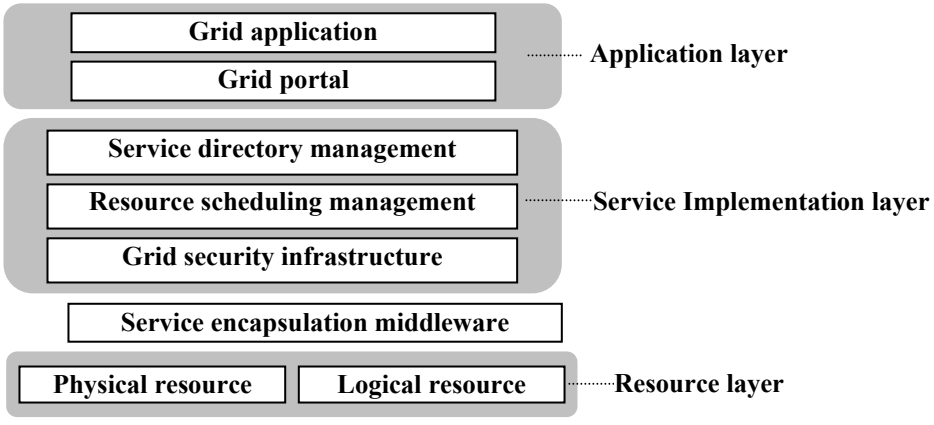

Fig. 2. The system architecture of SGAP

In WSRF, Web Service is stateless service, which running on stateful resource. Web Service and stateful resource is separated, the resources can be accessed by one or more Web Service at the same time. Based on

WSRF can structure the association relationship between Web Service and one or more stateful resources. Therefore, the Architecture of SGAP which is based on WSRF can be divided into three layers from the bottom to the top, resource layer, service implementation layer and application layer in turn, as shown in figure 2.

- Resource Layer: The resources in Resource Layer contain the physical resources and logical resources. The physical resources mainly refer to CPU, storage medium, large-scale instruments and other hardware resources. The logical resources are mainly made up of application program, software service, database and other software resources.
- Service encapsulation middleware: because the platform bases on the norm of WSRF, only the grid service which meets the norms can be deployed in service containers. But there are some legacy systems in enterprise, if we redevelop them, then it must bring the enormous waste. So, the function of Service Encapsulation Middleware is to encapsulate some Java application program and C application program, making them become gird services, and then deploy them in service containers.
- Service Implementation layer: the layer is made up of kinds of functional components, which can implement the service gird core function, including Grid Security Service, Resource Scheduling Service and Service Directory Management and so on. The several parts is some core functions brought forward in OGSA, it is the foundation of implementing application grid, and it is also the core components of SGAP introduced in the article. Grid Security Infrastructure mainly guarantees the security when the users access in grid environment, the questions need to resolve contain: when users access to multiple service resources must adopt single login mode, when working distribution and service scheduling, establish a safe rights delegation mechanism, when using other users' service resources, can't change or delete the resource when unauthorized. GSI is the core components of Glogus Toolkit 4, it can solve the grid environment security problems effectively. Therefore, Grid Security Infrastructure in SGAP adopts the GSI components in GT4 to implement [6]. Resource scheduling management is to process resources requests, execute remote application, allocate of resources and manage resource activities, and according to the resources situation, transmit the resource update information to directory management service. Grid resources scheduling management in SGPA adopts GRAM (Globus Resource Allocation Manager) components in GT4 to implement [7]. Service Directory Management mainly finishes the work for the service in grid environment to discover, query, register and modify, provide a true and real-time dynamic response for grid environment. Service Directory Management gathers information, and then releases it as Resource Attribute, and provides all the gathered information to client through a Web service interface. The client can query information for Service Directory Management, or subscribe the interested resource attribute. Service Directory Management can monitor resource, and follow the selected resource attribute, and when the attribute value changes to inform the subscribers. Service Directory Management in SGAP adopts MDS (Monitoring and Discovery System) components in GT4 to implement [8].
- Application layer: Grid Portal provides a kind of environment for users. The users can access grid resource and service, implement and monitor grid application programs, and also can cooperate with other users in this kind of environment. Gridsphere and Jetspeed are more popular among the current design grid portal, some of SGAP grid portal adopts the form of Web interface to feedback information to the users. First, the programs in grid portal page can obtain the shared service address and name information in grid servers through calling the MDS interface of Globus. After obtaining the information, the client codes in grid portal page analysis these information, and then show these information to the users in the form of browser table, convenient the client to query and use. Grid Application is based on the service implementation layer to implement the targeted application.

4. SGAP Work Mechanism

The work mechanism is shown in the Figure 3.

The new developmental service need to register to Directory Service Manager. Logging on procedure is the process of deploying the service to grid servers. During deploying, WSDL, WSDD and NJDI files of the service contain the information which register service need, grid servers analysis these documents, stored in

Service Directory Manager. To the remained Java application, such as EJB components, JavaBean and C application program can deploy to grid servers after encapsulated through service encapsulation middleware.

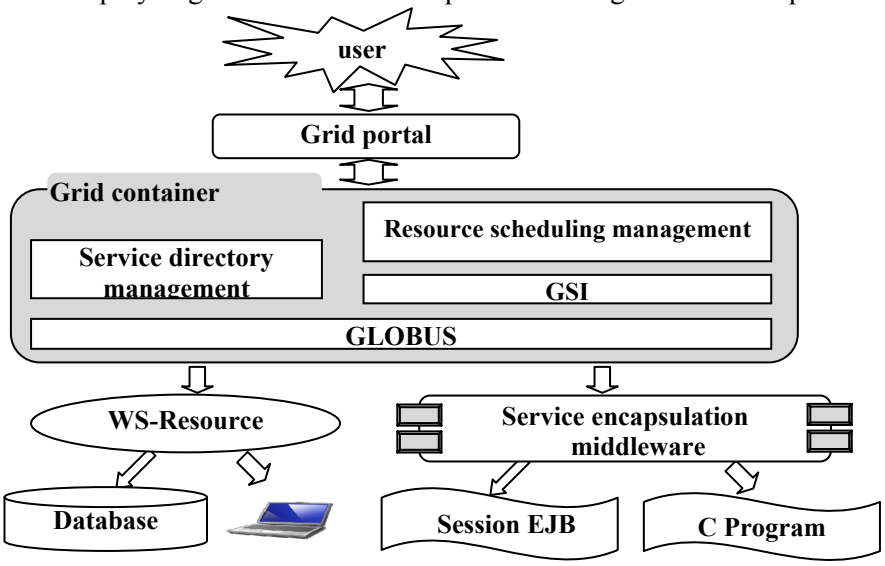

Fig. 3. The working mechanism of SGAP

Before users call the service, they need to query service. Users visit the grid portal in client, the grid portal according to users' request send the query information to Service Directory Management. After the Service Directory Management finding out the service information which matches condition, it will give the related information back to the grid portal, and then shows in list form. The information contains the service interface description and service address information. After obtaining the service information that can meet the users need, users can call the service directly through the service description information (for example WSDL documents) and address information (for example JNDI) provided by the grid portal.

5. Service Encapsulation Method

5.1 SGAP Service encapsulation general method

Encapsulating the physical resource and logical resource of grid environment and making it as service, it needs to building model the resources as the norm of WSRF, the resource call model based on WSRF is shown in the Figure 4.

In the platform, kinds of operation for resources all abstract to the Web service interface to release. When the users operate the resource, they need encapsulate the EPR information of operation service and the information which will be operated in the SOAP, and call the sharing service through SOAP.

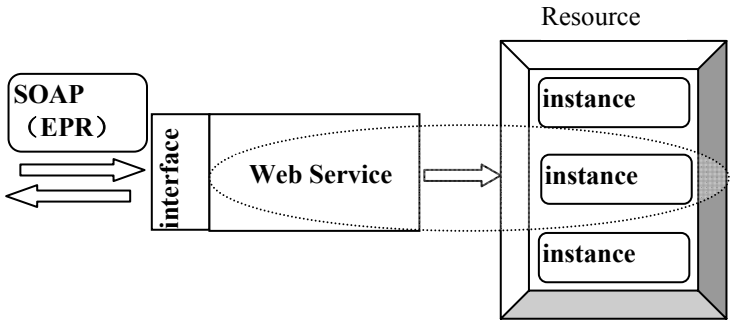

Fig. 4. Resource call model

Shared resource modeling need to abstract the resource as the form of "resources plus Web service". First, to kinds of shared resources, abstract the resource attribute (name, type, status etc.) information, use the WSDL (Web Services Description Language) to describe and then form the attribute documents. Then, abstract the operation which can execute on the resource, taking these operations as Web service, and then provide the interfaces to users. For example, sharing a printer as the internet use to provide the print service,

encapsulate the printer. First, abstract the printer attributes related, generally, they contain the printer name, type, idle status and so on. And use WSDL to describe and then form the attribute documents. After the attribute of the printer abstracted, need us to abstract the printer operations, which in generally contain changing its status, changing paper types, adjusting print mode and so on, then abstract the kinds of printer operations as Web service, show to the outside as WSDL document form.

5.2 Encapsulate EJB and C applications Program

Service encapsulation middleware in SGAP making the workflow of encapsulating the EJB components as service need 4 steps.

Step 1: prove the legality of the EJB, mainly including the correctness of File Type, Class File and Description File.

Step 2: Analyze Source File. File analysis tool of Service encapsulation middleware use the Document Object Model, DOM4J, to analyze the EJB description files in .jar and the server deployment files , and obtain the EJB class name information and JNDI information, and then adopt Java reflecting technology to analyze the .class files in .jar, in order to obtain the related interface information of EJB implementation class, and form the service description files of grid service though these information.

Step 3: Create service interface. Through the EJB interface information obtaining from above and the service description WSDL files, create the sharing service interface, and call the AXIS related toolkit, map the WSDL files as Java class files, and therefore generating server's service implementation files.

Step 4: Build deployment automatically. Generate the WSDD deployment files automatically, and then call the building tool Ant pack the grid service, and deploy and register to the service inside grid containers.

When encapsulate C application program, first of all, it need to encapsulate C program as Java file, and then proving java file of generated by validation tool , analyzing Java interface file of generated by File analysis tool , to obtain the class name information, interface information, message transfer information and more, and to generate WSDL description file, and then according the created WSDL file, call AXIS related toolkit to generate server's implementation files, and the last, generate WSDD deployment files automatically. And call the building tool Ant pack the grid service, and deploy and register to the service inside grid containers.

6 Conclusion

Application Platform of Service Grid suggested in the article, based on OGSA, combining with the norm of WSRF and the idea of service grid, encapsulates all the resources in grid environment as services, and implements the fusion of Web service and grid indeed. It has good expandability and universality. It provides the efficient solution in sharing and cooperating of kinds of application systems in enterprise. In the future, we will continue our research work, find more high-efficiency method, build more advanced the application platform of service grid, to adapt the need of the development of service grid application.

7 Acknowledgements

The authors wish to acknowledge the funding support from Beihua University of China.

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