Heterogeneous Information System Integration Based on HUB-SOA Model

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Abstract—Considering the problems of heterogeneous information system integration, service-oriented component of HUB-SOA model is proposed based on investigating E-HUB integration model and SOA integrated structure. Further, the key technical of the basic working principle, interface model, web service, system component and schema mapping are researched. What’s more, WEB service and its description of registration criterion for platform are defined, and service component integration architecture based on middleware is constructed, and the mapping model of heterogeneous information integration is proposed. Finally, the framework of HUB-SOA model with various heterogeneous systems is implemented.

Index Term—HUB-SOA model; SOA; Service component; Heterogeneous information system; System integration

I. INTRODUCTION

With the development of the internet, enterprise informationization has entered a period of rapid development, large and small “information island” has appeared in the enterprise because lack of overall planning when built all kinds of information systems. The heterogeneous information systems are unable to reengineering business process, unable to provide valuable decision information for leaders. The information system promotion of enterprise development at the beginning, but now it changed to constraints the development of enterprises.

Of order to solve the problem of heterogeneous systems interconnection and communication of different protocols between the systems at the current. Appeared connection point to point integration model for solve one system with another system interconnection at the early, Hub-Spoke integration model which provides a application integration center[1], enterprise service bus integration model which connects multiple physical center-nodes, service-oriented integration model with service as a distributed component and so on[2]. For this integration models, Some of the code complexity, More difficult to maintain.some of lead the efficiency of the bottleneck easily,appear single point of failure problem[3]. So research integration model have a positive value and practical significance which based on service-oriented and service component.

II. HUB-SOA MODEL AND ITS INTERFACE MODEL

A. Integration architecture of HUB-SOA model

SOA (Service-Oriented Architecture) framework is an oriented architecture of service, it independent of the platforms of hardware, operating systems and programming languages[4]. E-HUB is a information platform which is based on open e-business standards and internet technology, Provide interconnection of information, data sharing and business interactive for enterprise by plug-in. SOA combined with Plug-type E-HUB[5], formation heterogeneous system integration framework adapt to enterprise. It includes two main aspects of Service-Oriented integration and service component integration which can “plug”.

Figure 1. HUB-SOA model integration framework

HUB–SOA more open than the single Hub model, service component has unlimited expansion potential through service component; it truly embody everything is service, Hub deployment on the bus with the form of service, and constitutes the ESB of platform, it should be more flexible, this is the HUB-SOA. For traditional deficiency of SOA structure, We need a middle layer which can be achieved intelligent management of different services in SOA architecture, the framework shown in Fig. 1. HUB-SOA is a loosely coupled services and standards between of application integrate model which composition

Figure 2. HUB-SOA interface model architecture
by service component, It can be used Service-Oriented Architecture, Component-oriented architecture, Message-oriented architecture, Event-driven architecture.

B. Interface model of HUB-SOA

This paper combination mode of E-HUB, the service adapter deployment in the service bus with the form of plug-in, publishing by Web Service, forming HUB-SOA integration architecture. As shown in Fig. 2.

Heterogeneous system service interface of HUB-SOA model is mainly composed by the following layers.

- Service request layer is the entrance of HUB-SOA, mainly including service parser and rule configurator. According to the mapping and configuration rules, operation and analysis service request object, generates operation sequences, get the data returned by service parser, and converts the data into system data by call service adapter.
- The data analysis layer is an important part of the HUB-SOA, and mainly composed of a plurality of service adapters. According to the rules described by platform data, it converts the data into common formats which can be identified by platform, and submits the data to the business process engine.
- ESB implementation layer mainly includes business process engine, and is the core of the entire platform. It is in charge of the processing of business process for the overall platform, integrated data submitted from adapters and monitors the implementation of business.
- The service registry is mainly for realization the registration of the various heterogeneous systems service, equivalent to UDDI.
- Services mapping rules is mainly to complete the matching of mapping rules, and the choice of service adapters.

First, HUB-SOA integration framework takes component (adapter) as the internal services in ESB, Second, separating the service component from the ESB implementation engine, and convenient the "plug-in" for various adapters. By increase adapter components in architecture of SOA, the efficiency of the SOA is improved.

III. SERVICE COMPONENTS BASED ON HUB-SOA

Enterprise application integration is a tremendous and complex system, with components as its service units, and through the different service units composes the platform’s ESB, and this way of constructing can fully support heterogeneous system. Through registering the service components on the platform, the HUB-SOA model achieves WEB data conversion for various heterogeneous systems and submit the datum to the next service component object. The platform can quickly achieve the enterprise business restructuring., through a variety of loose "plug-pull" service components.

The service component achieves Web service discovery, binding, calling etc, through parse for service information by components, in order to shield the details of the client calling back Web services, accesses to local or remote Web service transparently. Due to the differences that WEB services received and returned provided by heterogeneous system, it needs convert the data which provided by each WEB services. The system structure and implementation principle of HUB-SOA model are as shown in Fig. 3.

IV. INTEGRATION AND MAPPING OF PATTERN ABOUT HETEROGENEOUS INFORMATION

In the heterogeneous information integration system, because data model of heterogeneous system is composed by different users, different time and location, it is independently designed based on different data models, may be exist a variety of differences and conflicts between them, in order to achieve the access and interactive of transparency to heterogeneous data, need to shield these difference and conflicts by research a way which can in the global level[6]. The mapped pattern found the inter-relationship between elements of pattern, then it set up the logical expressions of accord with semantics between elements of heterogeneous system through mapping. It is a key technologies about shield difference, conflicts and achieve integration of heterogeneous information system.

Definition 1. The mapping M of two data sources S1, S2 is a sets of mapping transformation model, has the following form.

\[ M = (E, R, F) \]

E is the set of element in model, R is the set of relationships to elements, and F is the set of formulas by defined in the (S1, M), (M, M), (M, S2), thus R is called as map of S1, S2 based on M.
Element e of each mapping model M have one formulas which is defined in (S1, M), or (M, S2) at least, indicating the source or destination of elements. According to the definition of M, under the connections of mapping M, you can always find a path from a data source to another data source, so as to define and achieve data synchronization effectively. The model structure can be shown in Fig. 4.

Set S1 is the data source and S2 is the target data source. By Definition 1, generate data mapping elements, such as shown in Table 1.

### Table 1. The Elements and Computing of Map M

<table>
<thead>
<tr>
<th>Mapped element</th>
<th>Formula</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>$S_1 = S_2$</td>
<td>Mapping by data</td>
</tr>
<tr>
<td>$M_1$</td>
<td>$\ell(S_1.F1) = M_1, M_1 = M_2, M_2 = S_2.F1, S_2.F2$</td>
<td>Data Source $S_1$-F1 achieve the data synchronzation to $S_2.F1$ and $S_2.F2$ by mapping M</td>
</tr>
<tr>
<td>$M_2$</td>
<td>$\ell(S_1.F2, S_1.F3) = M_1, M_1 = M_2, M_2 = S_2.F4$</td>
<td>Data Source $S_1.F2$ and $S_1.F3$ achieve the data synchronzation to $S_2.F4$ by mapping M</td>
</tr>
</tbody>
</table>

- To a tuple in the data source $S_1$, According to $\ell(S_1.F1) = M_1, M_1 = M_2, M_2 = S_2.F1, S_2.F2$, element F1 generates mapping data by the service component F and mapping rules M, and modifies $S_2.F1$ and $S_2.F2$ into the mapping of $\ell(S_1.F1)$, thus completes the transformation of elements.
- To a tuple in the data source $S_1$, According to $\ell(S_1.F2, S_1.F3) = M_1, M_1 = M_2, M_2 = S_2.F4$, realize the merger of data elements, and map them to $S_2.F4$, thus complete the transformation of the second element.

Through the above manner and establishment of mapping rules, set up a standardized and unified mapping model from the data source to the target data, while the mapping requires a unified service component to achieve F and discernible service description specification.

V. DESIGN AND IMPLEMENTATION OF SYSTEM

A. System design

This article analysis the heterogeneous systems, designed a ESB model about web service of HUB-SOA, provides a way to solve these problems, the integration about Web Services of HUB-SOA is divided into the following sections.

1) Module of WEB Service, Register the server of WEB services, and set up the mapping between the WEB services.

2) Module of Enterprise business process, This module is mainly used for standardized business processes, and coordinating the data processing, build the service of bus enterprise.

3) Module of Data Conversion, According to mapping information, parse the data source data into the content of identify about target data and stored in the database.

4) Module of Data Management, This module achieve the functions of the data layer of the system, connected the mode of string through the control of the switch (local database or distance database), the string of local connection stored in the XML file, stored the information of mapping about database into the database.

This paper achieves data synchronization between heterogeneous systems, the steps design is as follows and data flow diagram shown in Fig. 5.

**Figure 5. WEB Service Interface Data Flow Diagram**

1) Registry of WEB Service, stored the address of the WEB service, as well as the namespace of data conversion, name of method into the database, when the service provider to return the data can be reflective of the method used to convert the database.

2) Mapped the service, set the startup mode of service and its start time of the service.

3) If the mapping is manual mode, then the end of the process, otherwise jumped to Step 4 operation;

4) The system will put the mapping information into the monitor thread;

5) Platform obtained the data of returned from the provider of service, call the corresponding data converter to convert the standard platform for the corresponding XML structure data.

6) Dealing with business processes according to the setting of ESB, and dealing with the data.

7) XML data will be replaced by URL parameters, and pass the parameters to the target service to achieve the synchronize of data.

B. system implementation

Web service registration is the basis of service interface, We need to record the address of WEB services, the method of analysis WEB services and namespace. The interface of running system as Fig. 6 and 7.
VI. SUMMARIZE

Based on research of E-HUB and SOA framework, HUB-SOA model is proposed. Through further study the key technical of integrated information organization and description, Heterogeneous information integration and schema mapping, integration scheme and model based on middleware, Service-oriented interface model of heterogeneous systems; Through the study of xml language, description language specification based on xml of information integration is designed. the generality of integration model is improved, Business process that can really be portable and interoperable is realized. Through combination of these technical specifications, provides a viable, comprehensive and easily use framework for application of HUB-SOA architecture.

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