SERVICE-BASED DISTRIBUTED DATA MANAGEMENT AND APPLICATION IN CHINA DIGITAL OCEAN

Wen Dong[1] *Xin Zhang*[1] *Bing Jiang*[2]

(1. Institute of Remote Sensing Applications Chinese Academy of Sciences, Beijing, China; 2. China National Marine Data and Information Service, Tianjin, China)

1. INTRODUCTION

With the development of the ocean, the ocean environment and disaster issues become increasingly prominent, and so, global ocean observations and researches carries out step by step. In this case, requirements and productions of ocean data resources increase in a rapid speed, and the traditional centralized data production, management and application mode can not meet this demand.

With the developing of internet technology and the coming forth of the Web Service technology, the application of this technology in marine information areas has become an inevitable trend of development, and it also can promote ocean data management from simple distributed storage to distributed application.

In recent years, The Chinese Government and relevant departments invested a lot of money to support ocean observation and research, and now, they have accumulated a great large amount of ocean data and have built many marine business systems, management systems or application systems. On this basis, a plane of building a digital ocean prototype system for integrating existed results has been proposed, in which service-based distributed data management and integration is an important part.

Based on the analysis of the current status of ocean data resources in china, this paper proposes to apply web service technology in the design of the state-level distributed data management, and designs and realizes the data management and application mode of China Digital Ocean Prototype System according to this thought.

2. STATUS ANALYSIS

In recent years, ocean observation and investigation technology have developed rapidly, and a three-dimensional global ocean observation system has been formed [1]. At the same moment, some world or regional ocean observation projects and experiments which participated by a number of countries or regions carried out step by step. Such as the international ARGO project [2], Tropical Ocean Global Atmosphere (TOGA), World Ocean Circulation Experiment (WOCE) [3], and so on. These brought on the geometric accumulation and increase of ocean observation data and promoted data sharing researches. [4-9]

On the other hand, the development of data acquisition capabilities and global collaborative activities promoted professional research and application in ocean area, and then produced a large variety of ocean digital products. For example, Australia Bluelink Ocean Forecasting System can provide global daily surface sea temperature (SST) and other products for public. [10-12]

Construction of ocean observation and ocean information systems in China started relatively late, but now, we have initially built a three-dimensional ocean monitoring system which composed of ocean stations, buoys, research ships, maritime surveillance aircrafts, marine satellites and so on [13-14]. Meanwhile, we also actively participated in the global ocean scientific research activities, such as World Ocean Circulation Experiment (WOCE) and so on. [15]

This development brought on some new problems that traditional centralized data management and application methods can not resolve. Firstly, with the increasing of data amount, centralized management will bring

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tremendous pressure on network transmission and data security issues. Secondly, centralized management will lead to data duplication and synchronization problems inevitably between data production departments and data management center. Thirdly, because of the separation between data production departments and data application departments, centralized management will bring a great trouble for data application departments.

Therefore, there has an urgent need to establish a more efficient ocean information-sharing channel on the basis of distributed data storage and applications, and design a more conducive model for data mining will help us maximize the value of ocean data resources.

3. FRAMEWORK DESIGN

In order to solve the problems mentioned above, the concept and technology of web services have been introduced into the design of China digital ocean data management and application framework. Based on this concept, we design a four-layer structure, using service encapsulation technology to provide different data functions for application layer. In order to meet different user needs flexible, this framework provides several application modes to users, and they can choose the needed functions to build their own application, and also can use exiting application provided by center.

3.1. Data management and application structure design

In order to meet the distributed data storage and application request in china digital ocean prototype system, we need a kind of flexible mechanism to separate data application functions from other application functions. This paper proposes a web service-based multi-tier structure to build the data foundation of China Digital Ocean.

As figure 1 shows, this structure contain four layers in logic: basic layer, service layer, application layer and user layer.

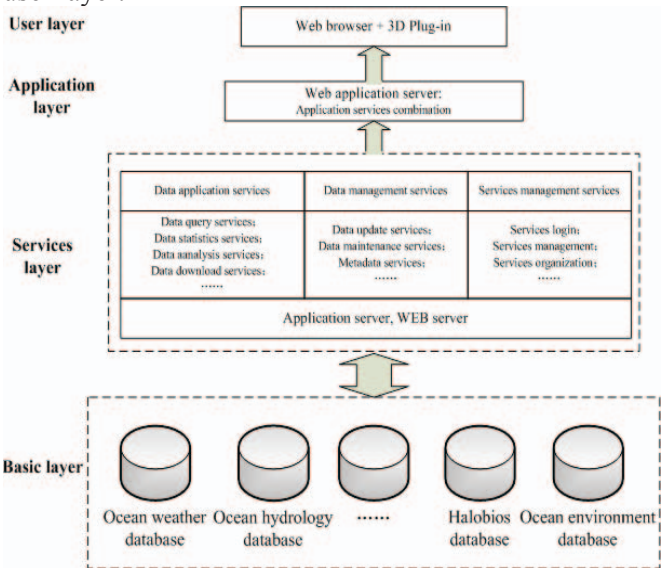

Fig. 1. Data management and application structure

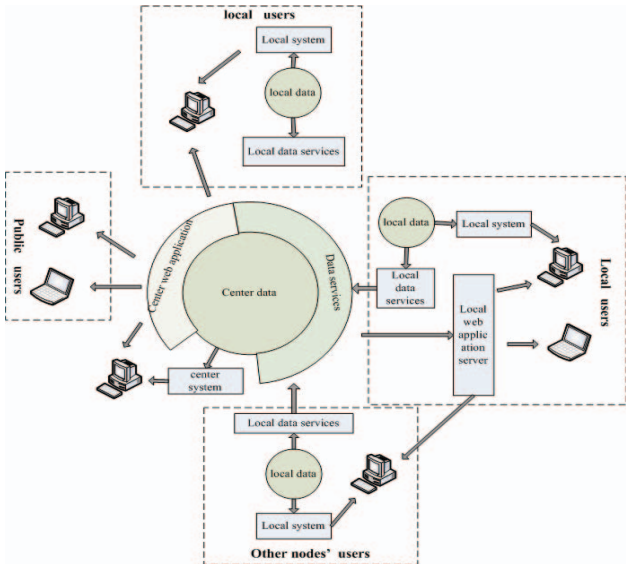

Fig. 2. Application modes

Basic layer is the base of this structure. Data can be saved in different methods and in different departments, such as saved in database in national center or saved as data files in someone's personal computer. In this way, every department can choose the most appropriate data storage and management method according to their own operation needs.

Service layer is an aggregate of data management, application and some relative services which are encapsulated by different data providers. It contains data application services, data management services and services management services, and reads data from basic layer and provide the results to information systems or some application services as input data or final users. These services can be used to realize some specifically functions, such as data query, data download and so on, and data services APIs are used to build new application for some special users.

Application layer is an advanced application layer. People use the services or services APIs provided by services layer to build new professional application systems and provide special applications for some special users. It is also a contact between users and data which distributed in different departments. When it receives a request, it estimates the type of this request and then calls the appropriate service. When application server completes the analysis, this layer gets the result and returns it to user layer.

User layer is the web Service requester and result displayer. System users' actions on web browser compose a request, and the request is sent to application layer, when application layer return the result of this request, user layer receive the result information and translate it to the information which person can understand and display it.

3.2. Data application modes design

Different users have different needs; this framework must have ability to provide the all data and relative functions in all departments for different users.

We can divide all possible users into three kinds: public users, local users and other net nodes' users. According to this division, as figure 2 shows.

Public users' application mode is the simplest one. These users just want get some interested information from services providers, such as, disaster prediction information. They need to get the information speedy and correctly, but their demands are simple in most moment. We can develop a unified web application for all public users, and what they need to do is visiting the home page of national center and proposing their requests, and then getting the result.

Local users have three kinds. One has its own application need which are absolutely different from most of other users, and this application need to use other nodes' data. They create their own web application for their sub-users in the same node and this web application access and use all nodes' data through data services. Second one has no special needs of functions. They just need to visit the home page of national center and proposing their requests as public users do. The third one uses their own data and original systems, and they need not to do any change for their exiting application mode.

Other net nodes' users mean that these users get their special analysis functions by visiting other node's web application system. If one node have the same application needs as the other node, and the follow node have created web application system for their sub-users. In this condition, we can use this application mode. Two nodes' users share the same local web application system. Using this method, local departments can save their money and time.

4. REALIZATION IN CHINA DIGITAL OCEAN

According with the above design, we develop the distributed data management and application modes in China Digital ocean prototype system. Basic databases and data services are created by all departments independently. National centre created a unified services management system, and local nodes' administrators can use this system to publish and manage their data services. And then different departments can choose a suitable model to build their own applications and public can use public application to get the information what they need.

Figure 3 shows one of the data services management system interface. It is used to publish data service, and the services publishers need to provide some needed services' metadata.

Figure 4 shows the data view result of last application model. This picture is a screen-capture of the result scene when people add remote sensing inversion production data which has been predicted by other department on basic 3D scene.

Fig. 3. Data services management system interface

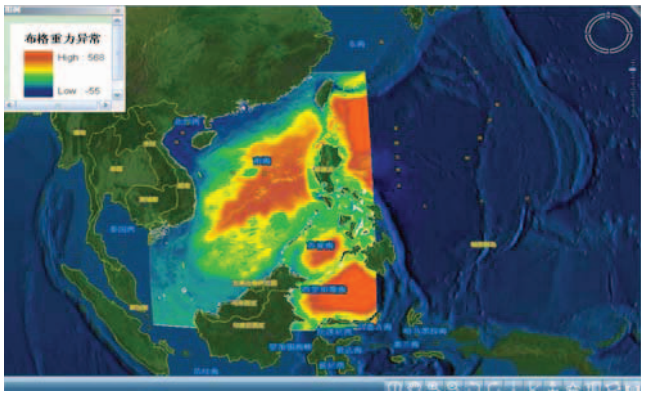

Fig. 4. Other nodes' data view result

5. CONCLUSIONS

Focusing on the problem of distributed data management and application in China Digital Ocean Prototype System, this paper proposes a framework design scheme on the base of web service technology to solve this problem. We design a four-layer framework structure and classification application mode to meet the demands of China Digital Ocean Prototype System in data management and application area, and realize this design in system development. In this system, all nodes' data can be accessed immediately with simple loose coupling way. In the future, the study will focus on the large amount data application efficiency in China Digital Ocean Prototype System.

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