Application of Cloud Computing in Geological Exploration

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Abstract. The wide application of information technology in geological exploration will greatly improve the modernization level of geological exploration. At present, geological survey information work has entered the era of big data. How to break the limitation of independent management of geological exploration database and effectively integrate and share the accumulated massive geological exploration data has become a problem that the geological exploration information workers are eager to solve. The emergence and maturity of cloud computing technology provides a feasible solution to this problem. Firstly, from the perspective of public welfare and the social service of geological exploration data, this paper summarizes and analyzes the application requirements of cloud computing in geological exploration work by studying the theoretical basis and relevant examples of cloud computing technology. Use Microsoft azure, SQL azure and other related products of Microsoft cloud computing platform azure to achieve the corresponding needs, research and clarify the relationship between geological exploration data and specific applications in geological cloud computing; use VMware vSphere virtualization platform to share existing and available hardware resources, and at the same time, research and build geoscience cloud storage mode based on virtualization technology to realize the sea Reasonable storage of quantitative geological exploration data; establishment of development environment with SDK provided by azure as the core for the development of application program of geological exploration data cloud computing; realization of data storage in the cloud for the purpose of integrating and sharing the achievement data of national mineral resource potential evaluation, and virtualization application of geoscience software.

Keywords: Cloud Computing, Geological Exploration, Big Data, Virtualization Technology

1. Introduction

Modern oil and gas geological exploration and development need to rely on advanced information technology for strong support[1]. High performance computing cluster, 3D visualization graphics workstation, massive data storage equipment and professional application software with different functions can provide a solid technical support for more accurate reserves prediction and more efficient comprehensive decision-making[2]. In recent years, with the increasing tension of global oil
and gas resources and the huge demand of various industries for oil resources, the strength of upstream exploration and development of oil companies has gradually expanded, followed by the rapid expansion of production equipment and a large number of deployment of various applications[3]. However, due to the lack of unified planning for resource deployment in the early stage, single cluster or server and other computing devices are all configured with independent application software, and the resources cannot be fully shared among the devices; moreover, computing resources and storage resources are mostly heterogeneous devices, and it is difficult to effectively integrate and expand between different brands and architectures, resulting in resource waste, management difficulties, high operation and maintenance costs[4-5]. At the same time, the rapid expansion of business makes more and more researchers from different places and overseas, and the local application mode cannot meet the production requirements[6]. How to make full use of the existing resources, through automatic management, for local and non-local personnel barrier free use, is the current problem to be solved, otherwise it will seriously affect the progress of scientific research projects and the long-term development of core business[7-8].

In order to solve this problem, we have made many positive attempts[9]. For example, using San to build shared storage architecture, building cluster unified job management system, creating resource management platform and so on[10]. To some extent, these technologies alleviate the problems of low resource utilization and complex management and maintenance. However, in order to realize the comprehensive sharing of resources, make more efficient and convenient use of various resources, and expand and deploy heterogeneous devices anytime and anywhere, we need to rely on advanced cloud computing technology. Exploration geological database has developed rapidly in the United States, Canada, France, Germany and other western countries. Since 1980s, it has been widely used in many countries. At present, two-thirds of the world's large enterprises have established or are establishing their own Internet / Internet information management system, and quite a number of large and medium-sized enterprise information applications are known to be built on the cloud computing database system. In the field of petroleum geological exploration, after many years of practice and research, researchers have accumulated a large number of achievement data[11]. For the management and use of these achievement data, each company is establishing various databases, so that researchers can free themselves from the tedious collection of data and other non-research work, thus creating favorable conditions for researchers to conduct quantitative research on problems[12].

This paper analyzes the necessity of building cloud computing environment in the field of petroleum geological exploration, points out the working principle, key technology and application value of cloud computing combined with the nature of core business, and probes into the virtualization, resource integration, collaborative work platform and remote application technology involved in cloud computing. Therefore, it is necessary to combine cloud computing technology with database technology to develop dynamic cloud computing database application, which is also an important sign of the modernization of petroleum geological exploration research.

2. Method

2.1 Definition of Cloud Computing Technology
Cloud computing is defined as a new computing method based on the Internet, which provides on-demand computing for individual and enterprise users through heterogeneous and autonomous services on the Internet. Cloud computing resources are provided through the Internet, and have the characteristics of dynamic, easy to expand and virtualization. "Cloud" is a kind of virtual computing resources that can be self-maintained and managed. It is usually a cluster of large servers, including computing servers, storage servers, and broadband resources. In this environment, computing tasks are distributed on these resource pools composed of a large number of computers, so that various application systems can obtain computing power, storage space and various software services as required. Generally speaking, cloud computing has the following advantages: 1) in terms of business needs, it can reduce it costs, simplify it management and quickly respond to market changes; 2) in
terms of operational needs, it can standardize processes, reduce costs and save energy; 3) in terms of computing needs, it can execute more data and accommodate more users.

2.2 Key Technologies of Cloud Computing
(1) Virtualization and resource integration technology
Virtualization is an important feature of cloud computing. Virtualization technology can dynamically organize a variety of computing resources, isolate the close dependence between specific hardware architecture and software system, realize transparent and scalable computing system architecture, flexibly build a computing environment that meets a variety of application needs, improve the efficiency of computing resources, play the aggregation efficiency of computing resources, and provide personalized and universal computing resources for users. Use environment.

(2) Collaborative work platform
Collaborative work platform is the upper application based on Virtualization in cloud computing system, which is mainly responsible for resource management, task management, user management, project management and security management. With this platform, the usage, running status and configuration information of existing resources can be displayed in a centralized way, and the workflow can be electronically managed, so that all kinds of users can carry out collaborative research and operation of different work in a unified interface, providing a unified, efficient, safe and reliable high-performance computing environment and management mode for researchers and system managers.

(3) Remote application technology
Remote application technology is a prerequisite for building a desktop cloud system in a cloud computing environment. By using remote application technology, the application is centrally deployed in the enterprise cloud. Users can access all kinds of resources anytime and anywhere without the limitation of location and distance. System managers only need to manage and maintain the application server to solve most problems, shorten the response time of failure, and improve the efficiency of operation and maintenance. At the same time, the remote application technology makes the transmitted image quality not affected by distance by means of image compression, graphics rendering and other means, which guarantees the demand of scientific research. Through the remote application technology, multiple users can access the same application server at the same time, realize the collaborative work in different geographical locations, greatly improve the utilization of resources, and increase the flexibility of work.

3. Experiment
Step 1: First of all, the design of geological exploration information management system takes sharing data resources as the goal, computerization of basin exploration and production management as the main line, production and scientific research needs of each scientific research department of basin Exploration Institute as the main content, and unified, perfect and standardized basic data and scientific research achievement maps as the premise to form a complete set of basin exploration graphic database system. In the logic structure design of the basic database, the data dictionary of oil and gas exploration information issued by China National Petroleum Corporation is referred to. The whole database system fully conforms to the standards of the oil industry and the state. At the same time, it ensures that the database can be smoothly connected with other exploration information databases of the oil industry, with good consistency and expandability.

Step 2: Secondly, with the thought, technology and method of Internet, the multi-disciplinary technical knowledge such as computer cloud computing technology, database application technology, basic data publishing and browsing query technology, scientific research achievements map publishing and browsing query technology are applied to all aspects of the software of exploration information management system, so as to realize the high unity and sharing of all kinds of data of geological exploration and production. The software of basin exploration information system is running on win95 / 98 / 2000 Chinese platform. The basic data management system is developed by Power
Builder, Oracle network database platform, ASP and IIS5.0,

Step 3: Finally, the exploration information management system is an important part of the network information system of the whole research institute, and also a part of the network information system of the whole oil field. Therefore, in the construction of cloud computing database, we must strengthen standardization and adopt unified technical specifications to realize network interconnection, resource sharing, efficient operation and scientific management.

4. Discuss

4.1 Analysis of Experimental Results

In this paper, based on the cloud computing big data survey site geological stratification survey data is shown in Table 1.

| Number | Data item name | Field Name | Types | Width | Primary key | Foreign key | Non-null |
|--------|----------------|------------|-------|-------|-------------|-------------|----------|
| 1      | Well           | JH         | var char | 16    | Yes         | Yes         |          |
| 2      | Stratum name   | DCMC       | char   | 20    |             |             |          |
| 3      | Horizon        | CW         | char   | 10    |             |             |          |
| 4      | Bottom depth   | DJSD2      | numeric | 7     | 2           |             |          |
| 5      | Thickness      | HD         | numeric | 7     | 2           |             |          |
| 6      | Contact relation | JCGX  | char   | 10    |             |             |          |
| 7      | Package mark   | FZBZ       | bit    | 1     |             |             |          |

With the continuous improvement of cloud computing technology, the effect of cloud computing applied to geological exploration is gradually enhanced, accelerating the transformation and upgrading of oil and gas geological exploration and development, and reducing the cost of geological exploration and development, as shown in Figure 1.

![Figure 1](image-url)

**Figure 1.** Cost changes of oilfield geological exploration and development in recent years

As can be seen from the data in Figure 1, the US shale oil and gas geological exploration revolution
caused by the progress of cloud computing technology has reversed the trend of us oil and gas production costs and profoundly affected the world energy pattern.

4.2 Application Value of Cloud Computing

(1) Important support for oil exploration and development strategy
Under the background of fierce competition for oil resources in the world, strong technical support and service guarantee are needed to realize the oil and gas exploration strategy. In the process of opening up overseas market, cloud computing system can provide convenient and efficient computing services for staff distributed in all regions of the world, and provide sufficient technical support for opening up overseas market.

(2) Save costs and expenses
In cloud computing, it operation and maintenance services concentrate data and even applications on the cloud, that is, the servers in the data center. This means that a large number of local operation and maintenance work will be transferred to the cloud server, the overall operation and maintenance workload will be greatly reduced, and the operation and maintenance cost will be greatly reduced.

(3) Resource optimization and long-term benefits
Cloud computing system can maximize the use of server, storage and network resources, improve resource utilization by 30% - 40%; it can provide better flexibility for the system through dynamic capacity configuration and fault recovery capability. In the long run, it can effectively reduce costs, improve revenue, and achieve huge economic benefits.

(4) Flexibility and scalability
Using cloud computing system can easily expand the virtual environment of the whole enterprise. Virtual infrastructure can provide more bandwidth, storage resources, computing resources and application software. Through a future oriented platform to support existing and future applications, there is no need to write or modify the running cloud, so as to obtain greater flexibility.

(5) Green environmental protection, in line with the low-carbon concept
Cloud computing can virtualize and share resources among different applications to improve server utilization. Servers can be shared between multiple operating systems and applications, reducing the number of servers. Less servers means less space, less operation and maintenance costs, less power and less pollution, so it saves cost and energy, which can be called Green IT technology.

(6) Optimize purchasing strategy
The centralized hardware infrastructure and centralized management software and data brought by cloud computing will promote the centralized procurement strategy of enterprises. The change of purchasing strategy will bring lower cost of ownership of hardware and software, especially the cost of ownership of hardware. At the same time, the cost of hardware operation and maintenance is reduced.

5. Conclusion
Through the construction of cloud computing system, the existing computing resources are planned to be included in the cloud system. Through centralized deployment and unified planning, the production scale is formed to meet the application requirements of high-precision exploration, pre-stack depth migration, large-scale overall reservoir numerical simulation, and effectively support the development of exploration and development core business. Realize the transformation of investment mode from decentralized investment and allocation to unified investment and centralized allocation; the transformation of application mode from independent application and independent administration to integrated sharing and collaborative work; the transformation of management mode from competing for equipment and resources to unified allocation and on-demand use. Through virtualization and resource integration, reduce the operation and maintenance costs of personnel, computer rooms and other equipment to achieve energy conservation and emission reduction; through the change of service mode, allocate resources to users on demand, realize global remote application access, and meet the business needs of international exploration and development.
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