Research Article
Discussion on the Application of Cloud Computing in Agricultural Information Management

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Abstract: In order to solve the problem of "Last Mile" in agricultural information management, it is imperative to introduce the cloud computing platform. The cloud computing will bring revolutionary changes in the management of agricultural information resources. This study based on the description of the basic connotation, technology and the characteristics of cloud computing, analysis the feasibility that cloud computing application in the management of agricultural information resource and the current problems in China. Furthermore, it puts forward the model of management in agriculture information resource and analysis its applied prospects and problems that must be attention.

Keywords: Agriculture, application, cloud computing, information management

INTRODUCTION

In recent years, with the development of information technology, the infrastructure construction in rural areas has been greatly improved in China. However, the "last mile" problem still exists. It always plagues the department of agricultural information. Cloud computing as a mode of business service is applied in various fields and brings some new ideas to agricultural information management and service. Cloud computing with its unique advantages will play an unlimited role in the field of agriculture information management. Thus, to discuss the application of cloud computing in agriculture information has important theoretical and practical significance.

In domestic, the government pay a lot of attentions on cloud computing. In December 2011, the data center project of telecom cloud computing settled in Hohhot in China. In the period of "Twelfth Five-Year", the scale of China's cloud computing industry chain will up to between 750 and 1000 billion. At present, the development plans of cloud computing which are starting all over the country are "Xiang yun Plan" in Beijing, "Yun Hai Plan" in Shanghai, "Tianyun Plan" in Guangzhou and "Cloud computing industrial union" in Wuhan.

Developing cloud computing is an important opportunity to catch up with the world advanced level, meanwhile, it is an important opportunity to carry out industry applications for agriculture and rural areas and also, it is necessary for developing information agriculture and agricultural public service. Cloud computing is the trend of information technology in the future; it is an applied mode of new commercial services which has a broad applied prospects, the development of agriculture and information technology are closed linked.

The study purpose of this study is to analyze the current status and the existed problems in the developing process, introduce the advantages of cloud computing and construct agriculture management information system based on the technology of cloud computing, explore the theoretical foundation and technical support of cloud computing technology in agricultural information and provide a source of power for the development of agricultural information.

CLOUD COMPUTING OVERVIEW

Connotation of cloud computing: Cloud computing has always been concerned since it generated and is known as the third IT industry revolution. Its goal is to provide a set of public facilities with computing, services and applications. Just like as easy to use computer resources as use water, electricity and gas in daily lives. However, when it comes to its definition, it has not yet formed a consensus neither at home nor at abroad. Among these, a representative definition is defined in Wikipedia: Based on the internet, the shared hardware and software resources and information could be supplied to the computer and other devices on their demands (EB/OL, 2011a). There is also some opinion believe that cloud computing is the business computing model based on the internet, it takes use of the high-speed internet transmission capacity, make the data

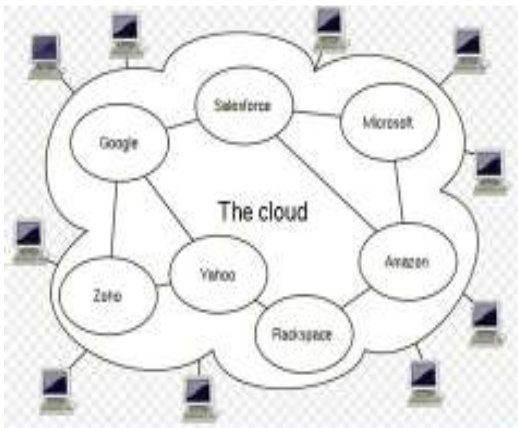**Corresponding Author:** Qingli Xia, Huanggang Normal University, Huanggang, 438000, China
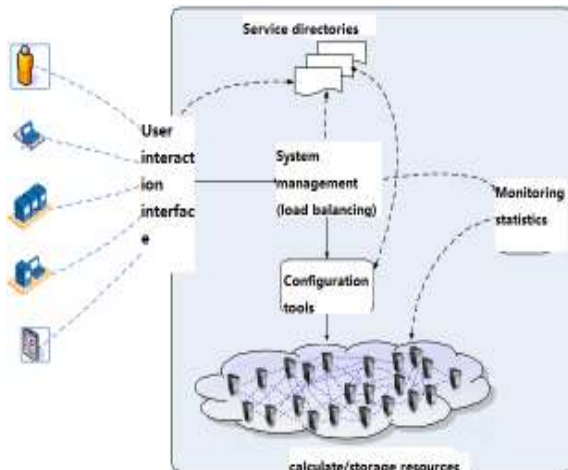
Fig. 1: Cloud computing

Fig. 2: The simplified IaaS implementation mechanism

processing process from a personal computer or sever to a cluster of servers on the internet (EB/OL, 2011b).

"Cloud computing" is a new model of network application that proposed by Google. The narrow sense of cloud computing is obtaining the necessary resources through network. In a broad sense, cloud computing refers to the delivery and usage mode of services. That is, to acquire the services that they need through the network on-demand. In a word, through the cloud computing which has unique functions such as ultra-large-scale, virtualization and reliable, the providers can handle a large number of information within few seconds and to achieve the same powerful performance as a "super computer". It is shown by Fig. 1.

The characteristics of cloud computing: The core of cloud computing is to manage and schedule the information resource by unifying and form a pool of resources to provide services to users. The so-called

"cloud" is the network that provides resource, for the users, the resources in the cloud could be unlimited extension and on demand to pay by volume at anytime or anywhere, therefore, it has some characteristics as follows (Chen *et al.*, 2011):

- **High elasticity:** Cloud computing as a massive resource pool, it could be dynamic stretching according to the applied resource, dynamic expansion of resources when it is in high load and release excessive resources when it is in the low load, thus, it can improve the efficiency of resources.
- **High reliability:** In the process of cloud computing, all data and programs are stored and run in the cloud, computing is also processed by cloud, cloud services are distributed on the respective servers, it can hand the failed node automatically and ensure the computing and related applications can run smoothly.
- **High flexibility:** For users, it can take advantage of the technology infrastructure resource quickly, the implementation mechanism of cloud services is transparent, the users could obtain the services that their own needs not by mastering the cloud computing mechanism.
- **Low cost:** Due to some users use cloud computing are not frequently or only one-time, if they purchase the expensive equipment, it will increase their cost, the infrastructure of cloud computing is often provided by the third party and calculated by the amounts which will greatly reduce the user's cost and reduce the knowledge requirement of theirs.
- **High share:** It can be used by many users which prevent individual users bear the cost is too high.
- **High independence:** The users can access the system by the PC or other devices and not constrained by the location and time, just as obtain the information and service by the internet.

The related technology of cloud computing: Cloud computing is the combination by traditional computer technology and network technology including grid computing, distributed computing, parallel computing, utility computing, network storage technologies, reutilization and load balance. It is designed to integrate a perfect system with high strong computing power and with the help of SaaS, PaaS, IaaS and MSP to distribute the computing power to the end-users. Ding and Yan (2012)

Next we take the IaaS cloud computing as example to outline the implementation of clouding computing mechanism which is shown in Fig. 2.

The interactive interface of users provides application with a form of Web Services and obtains the

users' requirements. The directory of service is a list which the users can access. The module of system management is responsible for managing and allocating all available resources, its core is load balancing. The configuration tool is responsible for preparing the operated environment at the allocated node. The module of monitoring statistics is responsible for monitoring the running status and finishing statistics of nodes. The process of implementation is not complicated: the interactive interface of users allows them to choose and invoke a service from the directory. When the request is passed to the module of management system, it will allocate appropriate resources for users and then invoke configuration tool for them to prepare operating environment (Huo *et al.*, 2012).

The status and the problems that in the agriculture information management of china: In recent years, China's agriculture information is focused on the information technology infrastructure and agricultural information services. Different functions and different types of agricultural management information system have emerged. Through years of construction, agriculture information infrastructure has made great achievements, such as "villages" project, "agriculture project" and "three-in-one works" and so on. These constructions made a solid foundation for agriculture information services. Qian (2012) but currently, in the process of constructing agriculture information, there exists some problems such as "highlight hardware, overlook software, low quality of the information, cannot meet the reality needs of farmers, farmers couldn't apply the practical information and information could not have some impact on farmers and so on" (Qiao and Liu, 2006)

THE UTILITY AND THE MODEL OF AGRICULTURE INFORMATION RESOURCES UNDER THE CONTEXT OF CLOUD COMPUTING

Agricultural information resources and services are to take different approaches to provide the required information that the farmers need, in this process, the mode of service are changing with the changes of the external environment. At the first stage, it transform information to farmers mainly by face-to-face. At the second stage, it transforms information to farmers mainly by media and printed materials. At the third stage, it transforms information to farmers mainly by telephone, network and so on. Also there are some new rural construction areas; they establish" Rural Book House" to transform information. At the fourth stage is the cloud computing stage, it mainly through several of

convenient terminals and combine the network to obtain the required information. Cloud computing as a business computing and storage mode, its research contents covered the fields of agricultural information services; as a technology, cloud computing brings some new technology, new methods and new ideas for agricultural information and it have a great impact on agricultural information services. Thus, with the development of cloud computing, it can drive the development of agricultural information services and transform the mode of agricultural information services, which embodied in the construction of agricultural information resources mode, agricultural information resource utilization mode, agricultural information services operation mode.

Construction mode: Agricultural information resources services take the construction of agricultural information as a precondition, under the context of cloud computing, the construction of agricultural information resource is gradually sharing. Cloud computing is based on a wide range of computing resources and storage resources, which can dynamic invocation and allocation resources, therefore, it is needed to achieve the resources sharing. In this process, the biggest problem is to uniform the data format, in order to improve the quality of service, the service business need to uniform the data standards, therefore, it is needed to harmonize the data, in order to develop the deep levels of services. From the point of agricultural information service organizations, different agencies have the different characteristics of agricultural information resources. Under the condition of cloud computing, the different agencies could use the common space to storage messages, sharing the infrastructures which provided by the cloud service provider, without requiring purchase the storage equipment, the resources of agricultural information will be all storage d on the cloud server, therefore, the same information environment can provide the basis for the sharing of agricultural information resources. Under the condition of unified data standard and the physical storage environment, it became very easily to sharing agricultural information resource, meanwhile, it can provide a guarantee for agricultural information services.

Utility mode:

- **Accurate calculations of quantum:** To access the agricultural information resources which based on the mode of cloud computing, it not need to purchase their own infrastructure construction
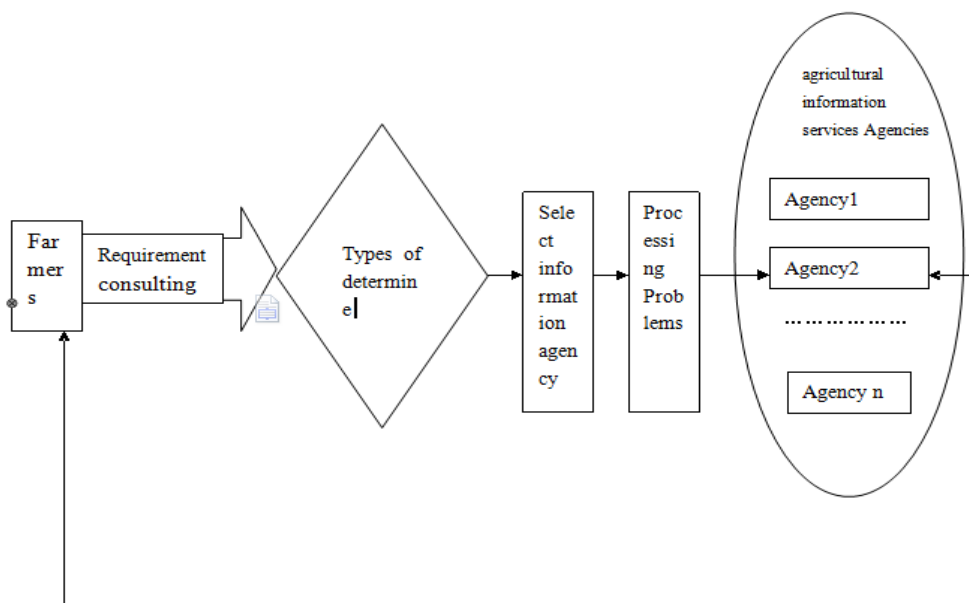
Fig. 3: Agricultural information consulting model under the cloud computing environment (Li *et al*., 2011)

resource center, without building a service platform and only need to obtain the necessary resources and services. Therefore, there need not to be many more centers, it could provide farmers with efficient information services and make the billing more accurate.

- **Unified search conveniently:** In the rural areas, due to the farmer's ability is limited and couple with their low educational level, so it requires the operation as simple as possible. The cloud computing environment just to meet these needs for farmers. The cloud platform is no longer using the traditional information retrieval mode; it takes integrated unified retrieval to the farmers. When the farmers put forward some requests in the system, the client directly send issues to the clouds, the resources dispatch center compute and storage resources and collect all the data results, finally give the results back to the users. In order to improve the efficiency of the massive resources and make it obtain more profits, the cloud services will strengthen the function of cloud platform and develop practical efficient integrated retrieval system, to achieve the finding for users and attract users to the platform. The power of cloud computing could be expansion unlimited when it is necessary, therefore, the way of information retrieval will no longer be constrained by hardware, at the same time, the speed and the accuracy will be further enhanced.

- **The unified advisory services:** Under the condition of cloud computing mode, the agency of agricultural information service take unified cloud platform to provide information consulting services to farmers. Farmers don't need to consider to whom solving the problem. Under the condition of cloud computing, the basic agricultural information and consulting model is shown by Fig. 3.

After the farmers put forward advisory requests and the platform of cloud service receive, it will determine the patterns and the characteristics of the problems and according to the advantages of different agricultural information service agencies, to specify an agricultural service agencies to answer the users' questions. The platform of cloud consulting could be seen as a black box between the farmers and the agricultural information services, it plays an important role of advisory scheduling, allocate resource and assist communication. In order to encourage the agencies of agricultural information services to participate in advisory services, the cloud platform will give those appropriate awards to incentive their enthusiasm for answering these questions. The advantages of this model are: the agencies of agricultural information services don't need to develop their own information consulting platform; this can save the costs of purchasing equipments and developing systems. And also it is conducive to play their advantages to provide a unified and high-quality service. Due to it adopts the model of joint services, so it will help the farmers to receive answers on time.

User Interface				
Telecommunications network	Television network		Internet	Transport layer
IaaS	**SaaS**	**PaaS**	**DaaS**	Application Services
Storage	Calculation software	Retrieval platform	Provide scientific data	
Calculation	Analysis software	Advisory platform	Literature resources	
....	....	....	....	
Network	Office Software	Intelligence platform	Human resources	
User management: User identity management;User request management;Calculate billing.				Cloud scheduling management
Resource scheduling management: Load balancing;Monitoring statistics;Fault detection;		**Security management**	Authentication	
			Backup and Recovery	
			Comprehensive protection	
Perception	**Identification**	**Acquisition**	**Classification**	**Polymerization**	Resource-aware layer
Two-dimensional code label	**RF code label**	**Readers**	**Global positioning system**	**Sensors**	
Document and Information Resources	....	Agriculture scientific data	....	Agricultural expert resources	Data layer
Standard system of information resources					
Server	**Storage devices**	**Network devices**	**........**	**Computer**	**Physical layer**

Fig. 4: Frame structure of agriculture cloud

In order to integrate the resource of agricultural science and technology and construct the center of agricultural science and technology services, data sources and a wide range of agricultural science and technology service network, bring together the first-class team of experts and to carry out agricultural information service, tele-consultation, video diagnostics and agriculture products online trading and so on, to solve agricultural science and technology information silos and services lag and other issues, there a project team explore the construction of agricultural cloud structure, Li *et al.* (2011). The following Fig. 4 shows the frame structure of the agriculture cloud.

The feasibility analysis that the application of cloud computing in agricultural information management: The operating feasibility for farmers: For the majority farmers, they need not to know the details of the infrastructure in cloud and need not to have the appropriate expertise and also need not to control directly. Under the mode of cloud, the user's computer will become very simple and perhaps small memory, no hard drive and software; it can also meet our needs.

Because the user's computer would do nothing in addition to send and receive commands and data through the browser to the cloud, but in this way, it also can use the computing resource, storage space and various application software. This is just like the wires which connect the "display" and "host" are infinite long, so we can place the "display" in front of the users, but the host on the far even the uses don't know where it is.

Cloud computing transforms the wire which connect "display" and "host" to a network, transform "host" into the server cluster of service providers. The computer cluster just as a "cloud", it could be used for you at any time, the users only need to input their own data to be processed and can get the results that they want. This process requires the users to pay cost, but the cost is lower than that they purchase computer equipment and software systems and also to maintain it. This technology is known as the "Cloud technology" and it makes people that don't understand computers can easy to use the computer as soon as possible. Just like the natural gas in household, it is only need to

know where the switch is, not necessary to know all aspects of gas production and transportation. By using cloud technology, it makes civilians can use the original superior sophisticated technology with lower cost; it is a huge step forward for human society. This is also the cloud computing platform's advantage that other technologies cannot match.

The cost feasibility of farmers: In cloud computing, the cost of the PC's configuration is very low, compared with the grid, the computing power of cloud computing, comprehensive and security are more superior, the architecture of cloud computing is a collection of resources, these resources could be managed dynamically and maintain the resource at any time. Bring the introduction of cloud computing to the construction of agricultural information if very feasible, the departments of agricultural can share the infrastructures which are connected together by a large number of systems, the cost of network will reduce and the efficiency will increase.

The existed practice for reference: Currently, there are a lot of areas have launch cloud computing platform and have achieved good results.

The "agriculture engineering" in Shandong is the first time to introduce cloud computing technology in the field of agricultural information in China and it provide new ideas for the construction of national agricultural information News (2011). The engineering research center of Hebei Province study the role that cloud computing play in the agriculture of things and create the applied model of cloud computing under the parallel algorithms. Their project which completed in 2009-base on the cloud model of rural science and technology information service platform (agriculture information cloud) won the award of Hubei Province science and technology progress. Dai and Chen (2009) In December 2011, the cloud computing data center project of telecom in China was officially settled in Hohhot, the total investment is expected to reach 12 billion Yuan.

Cloud computing is a new and revolutionary concept in the current, it enables users to liberate from the personal computer or small server system and makes them from the traditional mode of personal desktop-centric applications to the applied mode which based on virtual storage-centric. This mode can allow the computer or server which has poor performance plays a maximized function, agricultural-related agencies build data center to develop the storage computing services and this will enhance the speed and quality of the construction of agricultural information.

THE APPLIED PROSPECTS OF CLOUD COMPUTING IN AGRICULTURAL INFORMATION MANAGEMENT

Prospects: Cloud computing will change the way that people use to obtain agricultural information. The cloud computing infrastructure in the future will become an indispensable basis for people's lives. At present, people used to store and use their own data and related applied software, but in the era of cloud computing, the users need not to know where their own data is, they only need to put forward their needs to cloud computing and the cloud will meet all the propose requirements for the farmers.

The users only need to have one computer which can access internet, one browser and they can enjoy the endless fun that brought by cloud computing and they never need to worry about the virus of software and documentation, never need to re-install anti-virus software and firewalls, never need to worry about whether their own software is the latest version, because all of these have been done by the other side of "cloud", there are some professional IT staff help them maintain and update that previously made on the PC. Under the situation of cloud computing, people's concept using network resource will occur a radical change. Cloud computing will support the farmers access to application services at any wherever using various terminals. They request their resources from the cloud not from a fixed physical entity. The applications are run in the cloud somewhere, but in fact, the farmers don't need to know and don't need to worry the specific location of the application. They only need to a laptop or a cell phone and they can achieve what they want even the task of supercomputing.

According to CCID consulting, it predicts that in the next three years, cloud computing in China will gradually be more and more used by enterprise and institutions. Its market size will from 16.7 billion in 2010 to 117.4 billion in 2013. In the "Cloud high forum in China", many experts said that the cloud computing will greatly promote the construction of information infrastructure in China and the process of information.

The problems that should be noticed in the management of agricultural information of cloud computing: Using the technology of cloud to constructing agricultural information management system will enable 800 million farmers are in direct benefit, they don't need to pay much more costs and don't need to master advanced computer knowledge, they still can enjoy much more professional services and this will also enhance the agricultural production efficiency, make the guidelines which made by the

governments more scientific, more timely and more accurate. When constructing the agricultural information management based on the cloud technology, it is needed to pay attention the following questions:

- Establish a national standard of agricultural information
- Expand publicity to increase the degree of concern

At present, the cloud computing application in the field of agricultural information technology is not concerned enough, it is not yet arouse widespread concern by society and it should strengthen applied research in agricultural information services, introduce, absorb and promote its application in this field.

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