Privacy Preserving in Cloud Computing in the Field of Cultivation

V.K. Saxena
Vikram University
Ujjain (M.P.), India

Shashank Pushkar
Birla Institute of Technology
Mesra, Ranchi (Jharkhand), India

Abstract-India is an agricultural based country. The cloud computing technology will bring the revolution in rural India that is requisite to link the divide rural India and Urban India, and will develop the Indian rural economy. In India, the main source of returns is agriculture. So the growth of the information and communication technology is mainly determined on the Indian agriculture segment. Cloud computing is a common phrase used to express a novel class of network based computing that take place above the internet. These platforms conceal the intricacy and details of primary infrastructure from users and applications by given that very easy graphical interface. Most recent technological development has through a vivid change in every field and agriculture is no exception to it. Cloud computing technology impacted positively on agriculture field and related services they provide for users. Cloud computing implies a service oriented architecture, abridged information technology overhead for the user, great flexibility, abridged total cost of possession, on-demand services and many other belongings. It holds the potential to eradicate the needs for setting up of high-cost computing infrastructure for IT-based solutions and services that the industry uses. It promises to afford a flexible IT architecture, available through internet from lightweight moveable devices. This would permit multi-fold increase in the capacity and capabilities of the active and new software. This novel lucrative model for computing has found prolific ground and is attracting enormous global asset. In a cloud computing surroundings, the whole data reside over a set of networked possessions, enabling the data to be accessed during virtual machines.

Keywords: Cloud computing, Cloud agro system, Privacy preserving.

I. INTRODUCTION

Popularity of cloud computing is rising day by day in distributed computing environment. The internet is usually visualized as clouds; hence the term cloud computing for computation done through the internet. With cloud computing, users can access database resources via the internet from anywhere, for as long as they require, without distressing about any maintenance or supervision of actual resources. Besides, database in cloud are very energetic and scalable.

According to U.S National Institute of Standards and Technology (NIST), cloud computing is a model for enabling suitable, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or cloud provider interaction [7]. In simple words, cloud computing is the amalgamation of a technology, platform that provides hosting and storage facility on the internet [18]. In such surroundings users need not possess the infrastructure for a variety of computing services. In fact, they can be accessed from any computer in any part of the world. This integrates kind of supporting high scalability and multi-tenancy, offering improved flexibility in comparison to the previous existing computing methodologies. It can organize, allocate or reallocate resources with dynamism with an ability to endlessly monitor their performance [27]. In addition, cloud computing minimizes the capital expenses. This approach is device and user-location independent. Main goal of the cloud computing is to provide scalable and inexpensive on-demand computing infrastructures with good quality of service levels [13, 16].

Cloud Computing is a general term for anything that involves delivering hosted services over the Internet. Instead of stationary system architecture, Cloud Computing supports the ability to dynamically scale up and rapidly scale down, offering cloud customers high reliability, quick reaction times, and the flexibility to handle traffic fluctuations and demand [22]. Cloud computing also supports multi tenancy, providing systems configured in such a way that they can be pooled to be shared by many organizations or individuals [8]. Virtualization technology allows cloud vendors to exchange one server into many virtual machines, thereby

eliminating client-server computing with single-purpose systems [2]. This maximizes hardware capacity and allows customers to influence economies of scale [22].

Benefits of cloud computing are huge. The most important one is that the customers don't need to pay money for the resource from a third party vendor; instead they can use the resource and pay for it as a service, thus serving the customer to save time and wealth. Cloud is not only for multinational companies but it's also being used by small and medium enterprises [5].

The paper discusses the concepts of cloud computing, some of the issues related with implementation of cloud computing in rural agriculture of India. Section 2 discusses cloud computing building blocks. Section 3 discusses the preserving privacy of data in the cloud. Section 4 describes an approach towards preserving privacy of data in the cloud. Section 5 describes the scenario of Indian agriculture in context with cloud computing. Section 6 describes the proposed model for rural agriculture. Section 7 summarizes and concludes the paper.

II. CLOUD COMPUTING BUILDING BLOCKS

A. Deployment Models

The Cloud Computing model (Fig.1) has four deployment models, which are:

(i) *Public Clouds:* The cloud infrastructure is accessible to the public on a commercial basis by a cloud service provider. This enables a consumer to expand and organize a service in the cloud with very small monetary outlay compared to the principal expenditure requirements usually associated with other deployment choices. This environment can be used by the general public. This includes individuals, corporations and other types of organizations. Usually, public clouds are organized by third parties or vendors over the internet, and services are offered on pay-per-use basis. These are also called provider clouds.

(ii) *Private Clouds:* The cloud infrastructure has been deployed, and is maintained and operated for a specific group. The operation may be domestic or with a third party on the premises. This cloud computing surroundings resides within the boundaries of an organization and is used solely for the organizations benefits. These are also called internal clouds. They are built mainly by IT departments within enterprises who seek to optimize consumption of infrastructure resources within the enterprise by provisioning the infrastructure with applications using the concepts of grid and virtualization.

(iii) *Hybrid Cloud:* This is a amalgamation of both private (internal) and public (external) cloud computing environments. The cloud infrastructure consists of a number of clouds of any type, but the clouds have the capability through their interfaces to allow data and/or applications to be enthused from one cloud to another. This can be a combination of private and public clouds

(iv) *Community Cloud:* The cloud infrastructure is shared among a number of organizations with similar benefit and requirements. This may help limit the capital expenditure costs for its establishment as the costs are common among the organizations. The operation may be domestic or with a third party on the premises [17].

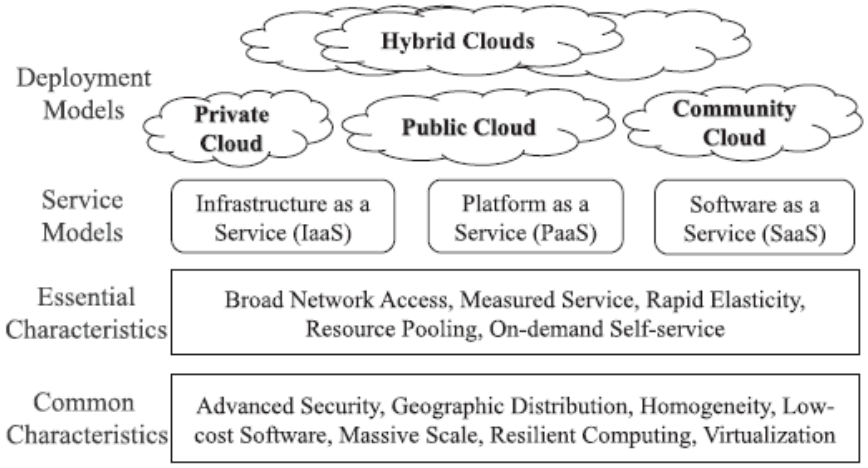

Figure 1: The NIST Cloud definition framework

B. Service Models

(i) *Software-as-a-Service (SaaS):* SaaS can be described as a procedure by which Application Service Provider (ASP) provide different software applications over the internet. This makes the customer to get free of installing and operating the application on personal computer and also eliminates the incredible load of software maintenance; continuing operation, safeguarding and support [4]. SaaS vendor advertently takes liability for deploying and managing the IT infrastructure and processes required to run and manage the full solution. SaaS features a complete application accessible as a service on demand. In SaaS, there is the Divided Cloud and convergence coherence mechanism whereby every data item has either the "Read Lock" or "Write Lock" [1]. Two types of servers are used by SaaS: the Main Consistence Server (MCS) and Domain Consistence Server (DCS). Cache coherence is achieved by the cooperation between MCS and DCS [14]. In SaaS, if the MCS is damaged, or compromised, the control over the cloud environment is lost. Hence securing the MCS is of great importance. Examples of SaaS includes: Google Apps and Salesforce.com.

(ii) *Platform as a Service (PaaS):* PaaS is the delivery of a computing platform and solution stack as a service without software downloads or installation for developers, IT managers or end-users. It provides an infrastructure with a high level of incorporation in order to implement and test cloud applications. The user does not administer the infrastructure, but he controls deployed applications and, possibly, their configurations. Examples of PaaS includes: Force.com, Microsoft Azure, and Google App Engine.

(iii) *Infrastructure as a Service (IaaS):* Infrastructure as a service (IaaS) refers to the sharing of hardware resources for executing services using virtualization technology. Its main function is to make resources such as servers, network and storage more keenly accessible by applications and operating systems. Thus, it offers basic infrastructure on-demand services and using Application Programming Interface (API) for interactions with hosts, switches, and routers, and the capability of adding new equipment in a simple and transparent manner. In general, the user does not manage the essential hardware in the cloud infrastructure, but he controls the operating systems, storage and deployed applications. The service provider owns the equipment and is accountable for housing, running and maintaining it. The client normally pays on a per-use basis. Examples of IaaS include GoGrid, Amazon Elastic Cloud Computing (EC2) and Amazon S3.

III. PRESERVING PRIVACY OF DATA IN THE CLOUD

Security has been a severe issue of concern in the cloud. The main motive behind this is that both the client data and the client code lies in the provider location. The following are some of the major issues associated to security [12]:

• Server Access Security
• Database Access Security
• Internet Access Security
• Program Access Security
• Data Privacy Security

Here, we are focusing on the data privacy security issue. Privacy is the protection of transmitted data from passive attacks [19]. The objective is to guarantee that the data required by client is not being accessed by or not being disclosed to any illicit person in the cloud. The client has to guarantee themselves that the providers are executing their security accountability. The general trend followed by clients for preserving privacy in cloud is as follows:

- Negotiate particular terms with their cloud provider.
- Implement compensating controls where possible.
- Assurance of the supplier regarding sturdiness of their service in preventing data from unauthorized access within a shared environment.
- Establishment of an agreement particularly with regard to physical verification.
- Get assurance from the cloud provider regarding security and fulfilment requirements.

The responsibility for safety is mutual between the customer and the service provider. To brawl back against these issues we are proposing a repository for preserving privacy of data in cloud.

IV. APPROACH TOWARDS PRESERVING PRIVACY OF DATA IN THE CLOUD

A privacy preserving repository for getting of integration requirements from customers to share data in the cloud and maintain their privacy, collect and integrate the appropriate data from data sharing services, and return the integration results to users. Repository basically concentrates on the harmonizing operations and is helpful in the following ways:

- The data sharing services in the cloud own the ability to update and control the access and usages of their shared data. That is, data can be updated when required and it can be incidental who is using the data and in what way.
- The allocation of data in the cloud is based on the need-to-share principle, which states that the dispatched information of the data is adequate to support clients' integration requirements, but carries no additional information of the data.
- The repository is restricted to gathering data from data sharing services and combining the data to satisfy users' necessities. The repository will contain no other information apart from that required to send the results to the client and it cannot use this data for other purposes.

V. INDIAN AGRICULTURE SCENARIO AND CLOUD COMPUTING

In spitefulness of the various ICT projects in India, the country is still facing various challenges:

- Lack of awareness among farmers about the repayment of ICT in agriculture.
- Poor production information.
- Insufficient knowledge about the weather forecast, threats from pests and diseases.

Cloud computing is available to determine these challenges. Besides using the cloud technology, farmers have nothing to be concerned about hardware and software reserves and also the technical knowledge to gain awareness. Farmer as user need to send a request to the service provider and by systematic analysis of request, result will be accepted back to the client. Cloud computing will give on demand opportunities through which data sharing and data collection is probable, which is very critical for agricultural research and development. This technology can propose a centralized knowledge database which can be used to accumulate all the agriculture related information.

Some of the probable solutions which can be provided by service providers to the farmers are:

- Prediction of weather and related information database.
- Database for crop based information.
- Database for market based information.

- Database for production based data.

Farmers can also place their problems looking for solutions from the professionals. With the help of mobile phone applications, farmers can immediately contribute to the knowledge database by uploading crop and soil related information, pictures, videos and any other information [6, 10, 15, 20, 21].

Advantages

- *Data management:* The data will be managed by the service provider, a team of professionals. That guarantees an improved and organized supervision of data.
- *Data readiness:* This provides data from the e-data bank databases to its whole stakeholder at any time and at any place.
- *Local and global Communication:* This makes the communication between different users much faster, easier and cheaper. Also the communication will be secured.
- *Rural-urban migration:* A major problem of the nation is rural-urban migration. It can be abridged as this provides its services all over the state and may also all over nation at any time no matter how remote the place is. This will also help in controlling unemployment problem in the state and country.
- *Motivation:* It will motivate the farmers and researchers to get concerned more and more into agriculture as any communication will be result oriented. That will result in overall development of this part in the nation.
- *Security:* It provides an improved security as the resources will be stored in cloud and will be organized centrally by the service providers. Thus, it is not a cause of concern for its users.
- *Reduction of technical issues:* It cuts short the manpower, protection and infrastructure requirement radically, as it will be provided by the service providers.
- *Overall economy:* Implementation of cloud computing in agriculture sector will help in elevating the agricultural sector of the country. That will improve the overall development of the economy. It is due to the mass contribution of different stakeholders, as the system will observe and deliver progress report each time and everywhere needed [3, 9].

Disadvantages

Although the execution of the cloud computing in agriculture indicates by and large growth of the agricultural sector in India and there are few concerns as well. One of the main concerns of cloud computing is the disagreement in different country laws. It demands a vigilant selection of the provider and may also require arbitration in drawing an effective agreement between the service providers and State. Another concern is the security and privacy. The nation may not be willing to hand over sensitive data to a third party. This can be taken care of by careful selection of dependable and reputed cloud service providers. One more important limitation is, cloud computing stress high bandwidth internet connectivity. The current international bandwidth of any state is 325Mbps, which is just sufficient to cater the basic needs in the state only, for entire India more than 1200Mbps is needed. For optimally use the cloud services India needs much higher bandwidth than the current capacity. One probable solution to this problem could be to incorporate certain services through mobile, especially text related services. [3, 9]

VI. PROPOSED MODEL FOR RURAL AGRICULTURE

The Structure of cloud Computing as we discussed in previous can be explain on the Basis of agricultural environment and study of the previous research of Bhutan [6, 10, 11, 15].

A. Cloud Agro System:

This part of the system can be used to monitor the overall functionalities of the system and make the needed services. The system will have online service facilities available to all the users, from any part of the country and at any time. In order to provide these services, the Agro system may have the following services

- *Demand-supply:* It will provide an up to date image of the current demand and supply information of agro products in different parts of the country. It helps the farmers in deciding on selection of the crops. It also provides space to go for a comparative analysis of the demand and supply chain.
- *Communication:* Majority of urban population are illiterate, who are in general farmers. As a result, the system will also have audio-visual facilities to broadcast information.
- *Communication devices:* The mobile services in India have enclosed almost all parts of the country and almost each family has access to it. Though bulk of the local farmers has never heard of ICT, they are

used to with mobile phones. Thus, the system incorporates mobile services and helps the farmers in acquiring information from e-data bank from anywhere, at any time, through mobile phones.

- *E-Knowledge sharing:* The system also keeps condition to have online communication with the experts/consultants and attend online training programs using the Community Service Centres (CSC) as the local information bases. The system is not limited to only local information; cloud agro is a global ICT approach. The system, therefore, will gather and broadcast agriculture related global information to the local farmers. This will be especially helpful if they need information that is not locally available or not yet implemented in India. Also farmers can be made alert of recent agro related concepts, such as "Organic cultivation" using this global ICT approach.
- *Conducting research:* It will help the national and international researchers to take out Indian agricultural data directly from the e-data bank and investigate them in order to contribute to the Indian agricultural sector of the nation. The research conclusion will be kept in the e-data bank and will be accessible to all its stake holders.

B. e-Data Bank:

It is an innermost data bank and it can be used to store all the agriculture related information in a centralized cloud, which will be accessible to all the users at anytime, anywhere. The main idea behind having an e-data bank is to broadcast vital information to the local farmers in decision making. In order to do so, the e-data bank includes the following databases:

- *Crop related information:* It captures information related to all the crops grown in recent past in different regions. This will help the local farmers of different parts of the nation in crop related decision making.
- *Weather information: I*t stores the area specific weather information and also the weather forecast for a specific period. It will helpful the farmers in decision making related to assortment of crops.
- *Soil information:* Soil information also plays a very important role in crop related decision making. So, this segment provides information on nature of soil of diverse parts of the country. It can also give the trend of soil in past and will help in forecasting the future trend of soil.
- *Growth progress monitoring:* It monitors and captures data on crop growth in diverse regions on a regular interval. This will be specially useful in comparing the crop growth region wise and also comparing it with past data will bring a clearer picture.
- *Farmer's data:* It captures the area wise farmer related data, to observe and study the participation of local farmers in Indian agricultural sector. It will help the policy makers in designing Indian agricultural policies. This will also help in identifying the core Indian agricultural areas, so that the policy makers can take decision on encouraging and promoting agriculture. This may help in overcoming problems such as unemployment and rural-urban migration.
- *Expert consultation:* It provides solutions to common problems that farmers frequently experience. It can also have a provision to post unattended problems seeking for solutions from the professionals. It will also have a collection of frequently asked questions (FAQs) and their answers to make the reply which reaches the farmers in right mode.
-

VII. CONCLUSION

Cloud computing can be seen as a new trend which is set to transform the way we use the Internet, there is much to be vigilant as regards. There are many latest technologies rising at a rapid rate, each with technological advancements and with the possible of making human's lives easier. Though, one must be very cautious to understand the security risks and challenges posed in utilizing these technologies. Cloud service providers need to inform their customers on the level of security that they provide on their cloud.

The proposed model for rural agriculture bridges information gap within and outside the nation. In Indian agricultural sector, the suggested model can be considered as a pilot project. An efficient implementation of this model will give confidence other sectors also, which will lead to most advantageous benefit of shifting towards cloud. This will absolutely have a positive impact in the overall economic development of the nation. Cloud computing is a recently introduced concept and most of the developing nations are not eagerly willing to accept and implement it. Therefore, it needs a mass attentiveness and promotion among the prime stakeholders to attain the full potential of it and have a well recognized information base for the nation. As the development of cloud computing technology is still at an early stage, this research effort will provide a better perceptive of the design challenges of cloud computing, and pave the way for additional research in this field.

REFERENCES

[1] Chen Gaoyun, Lu Jun and Huang Jian, Wu Zexu, SaaS: The Mobile Agent based Service for Cloud Computing in Internet Environment, Sixth International Conference on Natural Computation, ICNC, IEEE, Yantai, Shandong, China, pp.2935-2939, ISBN: 978-1-4244-5958-2, 2010.

[2] Foster I., Zhao Y., Raicu I., and Lu S., Cloud Computing and Grid Computing 360-Degree Compared, In: Grid Computing Environments Workshop, 2008. GCE'08, 10, 2008.

[3] Ghasura R.S, Patel H.B., Duthatra G.B and Choudhury G.M, WJAS, Cloud Computing: Future buzz for rural India, pp.255-266, Feb 2012.

[4] Grossman R.L., The Case for Cloud Computing, IT Professional, vol. 11(2), pp.23-27, ISSN: 1520-9202, 2009.

[5] Lord Crusader, Problems Faced by Cloud Computing, packetstormsecurity.net/.../ProblemsFacedbyCloudComputing.pdf.

[6] Meaotian, Qingli Xia and Hao Yuan, Discussion on the application of cloud computing in agricultural information and management, Research Journal of Applied Science Engineering and technology 5(8), pp.2538-2544, 2013.

[7] Mell Peter, Grance Timothy, The NIST Definition of Cloud Computing, Jan, 2011. http://docs.ismgcorp.com/files/external/Draft- SP-800-145_cloud-definition.pdf.

[8] Oliveira D., Baião F., and Mattoso M., Towards Taxonomy for Cloud Computing from an e-Science Perspective, Cloud Computing: Principles, Systems and Applications, Heidelberg: Springer-Verlag. 2010.

[9] Patel Rakesh and Chaube Anupam, A critical review of recent research on cloud computing in Indian rural agriculture, International Journal of Research, Vol. 1 (6), pp.800-810, 2014.

[10] Prasad M.S.V.K.V. G Jagadeesh Kumar, Naidu V.V.S. G.J. Nagaraju, Use of cloud computing in agricultural sector, A myth or reality, IJERT, Vol 2, issue 10, Oct 2013.

[11] Prasad Shitala, Peddoju Sateesh K and Ghosh Debashis, AgroMobile: A cloud based framework for agriculturist on mobile platform, IJAST, vol 59, pp.41-52, 2013.

[12] Rakshit, A. et.al., Cloud Security Issues, IEEE International Conference on Services Computing, 2009.

[13] Schaper Joachim, Cloud Services, 4th IEEE International Conference on DEST, Germany, 2010.

[14] Sen Sangeeta, Chaki Rituparna, Handling Write Lock Assignment in Cloud Computing Environment, Communications in Computer and Information Science, vol. 245, issue. 7, pp.221-230, 2011.

[15] Sharma Poornima, Necessity of education and awareness in farmers: The basis of agricultural progress in developing and under developed nations, Agriculture and Biology Journal of North America, 2010.

[16] Singh Gurdev, Sood Shanu, Sharma Amit, CM-Measurement Facets for Cloud Performance, IJCA, Computer Science & Engineering, Eternal University, Baru Sahib, HP, India, Volume 23 No.3, June 2011.

[17] Singh Gurmeet, Sachdeva, V.K., Impact and Challenges of Cloud Computing in current scenario, IJRC, Vol.1, issue 10, 2012.

[18] Singh Harjit Lamba and Singh Gurdev, Cloud Computing-Future Framework for e-management of NGO's, IJoAT, ISSN 0976-4860, Vol 2, No 3, Department of Computer Science, Eternal University, Baru Sahib, HP, India, July 2011.

[19] Stallings, W., Cryptography and Network Security, 3rd Edition, Pearson Education, New Delhi, p8, 2003.

[20] Szilagyi Robert, New information and communication technologies in agriculture-factors, drivers and application possibilities, Agrarinformatica/agricultural informatics, vol 3, no 1, pp.10-18, 2012.

[21] Thakur Avinash, Mano Ranjan Kumar, Yadav Ranjan Kumar, Cloud Computing: Demand and supply in banking health care and agriculture, IOSRJSE, vol 16, issue 3, ver 2, pp.96-101, May-Jun 2014.

[22] Vaquero L.M., Rodero-Merino L., Caceres J., and Lindner M., A break in the clouds: towards a cloud definition, SIGCOMM Comput. Commun. Rev., vol.39, pp.50-55, 2009.