



## Cloud Computing for Agricultural Information Management in India

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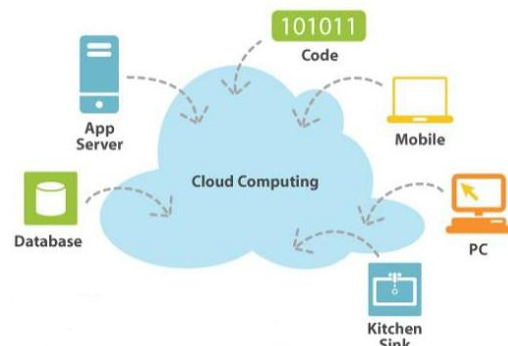
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**Abstract:** Use of Cloud computing technology in agricultural sector has greater opportunity in the overall development of India. An effective implementation of cloud computing is encouraging in agricultural sector. Cloud Computing is emerging today as a commercial infrastructure that eliminates the need for maintaining expensive computing hardware, software, IT staff, infrastructure, recourses and their maintenance. Through the use of virtualization, clouds promise to address with the same shared set of physical resources a large user base with different needs. Cloud storage enables users to remotely store their data and enjoy the on-demand high quality cloud applications without the burden of local hardware and software management. Though the benefits are clear, such a service is also relinquishing users' physical possession of their outsourced data, which inevitably poses new security risks towards the correctness of the data in cloud. The proposed design allows users to edit the cloud storage with very lightweight communication and computation cost. The editing result not only ensures strong cloud storage correctness guarantee, but also simultaneously achieves fast data error localization, i.e., the identification of misbehaving server.

**Keywords:** Cloud computing, Agriculture, Information, Management, India, IaaS, Paas, SaaS, NaaS

### I. INTRODUCTION

Cloud computing is an expression used to describe a variety of computing concepts that involve a large number of computers connected through a real-time communication network such as the Internet. In science, cloud computing is a synonym for distributed computing over a network, and means the ability to run a program or application on many connected computers at the same time. The phrase also more commonly refers to network-based services, which appear to be provided by real server hardware, and are in fact served up by virtual hardware, simulated by software running on one or more real machines. Such virtual servers do not physically exist and can therefore be moved around and scaled up (or down) on the fly without affecting the end user - arguably, rather like a cloud. Cloud computing is the next stage in the Internet's evolution, providing the means through which everything — from computing power to computing infrastructure, applications, business processes to personal collaboration — can be delivered to you as a service wherever and whenever you need. The “cloud” in cloud computing can be defined as the set of hardware, networks, storage, services, and interfaces that combine to deliver aspects of computing as a service.



Cloud services include the delivery of software, infrastructure, and storage over the Internet (either as separate components or a complete platform) based on user demand. Cloud computing has four essential characteristics: elasticity and the ability to scale up and down, self-service provisioning and automatic deprovisioning, application programming interfaces (APIs), billing and metering of service usage in a pay-as-you-go model.

The world of the cloud has lots of participants:

- The end user who doesn't have to know anything about the underlying technology.
- Business management who needs to take responsibility for the governance of data or services living in a cloud. Cloud service providers must provide a predictable and guaranteed service level and security to all their constituents.
- The cloud service provider who is responsible for IT assets and maintenance.

Cloud computing is offered in different forms: public clouds, private clouds, and hybrid clouds, which combine both public and private. Cloud computing can completely change the way companies use technology to service customers, partners, and suppliers. Some businesses, such as Microsoft, IBM SmartCloud, Amazon, HP, Oracle, Google, Yahoo, Rediff, TCS, Infosys, Zenith, Reliance data center, Dell, BSNL, NIC and ERNET already have most of their IT resources in the cloud. They have found that it can eliminate many of the complex constraints from the traditional computing environment, including space, time, power, and cost.

## II. CLOUD COMPUTING SERVICE MODELS AND PARAMETERS

Cloud computing is a general term for anything that involves delivering hosted services over the Internet. The name cloud computing was inspired by the cloud symbol that's often used to represent the Internet in flowcharts and diagrams. These services are broadly divided into three categories: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS). **IaaS** delivers computer infrastructure as a utility service, typically in a virtualized environment and provides enormous potential for extensibility and scale. **PaaS** delivers a platform or solution stack on a cloud infrastructure. Sits on a top of the IaaS architecture and integrates with development and middleware capabilities as well as database, messaging and queuing functions. Software as a service (**SaaS**) delivers the application over the Internet or Intranet via a cloud Infrastructure which was built on underlying IaaS and PaaS Layer. Other key components in anything as a service (**XaaS**) are described in a comprehensive taxonomy model published in 2009, such as Strategy-as-a-Service, Collaboration-as-a-Service, Business Process-as-a-Service, Database-as-a-Service, etc. In 2012, network as a service (**NaaS**) and communication as a service (**CaaS**) were officially included by ITU (International Telecommunication Union) as part of the basic cloud computing models, recognized service categories of a telecommunication-centric cloud ecosystem.

### Infrastructure as a service (IaaS)

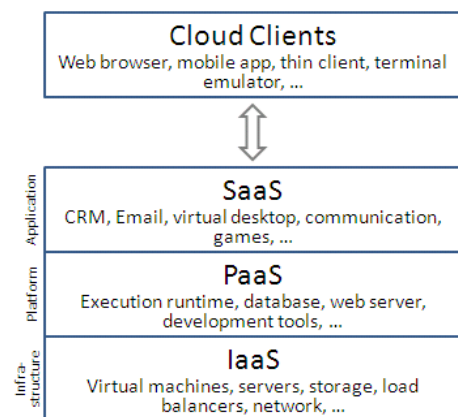
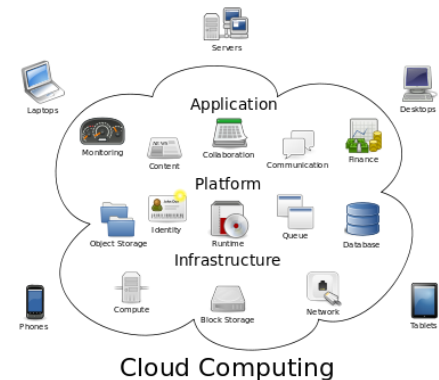
Cloud-service model, providers of IaaS offer computers – physical or virtual machines – and other resources. (A hypervisor, such as Hyper-V or Xen or KVM or VMware ESX/ESXi, runs the virtual machines as guests. Pools of hypervisors within the cloud operational support-system can support large numbers of virtual machines and the ability to scale services up and down according to customers' varying requirements.) IaaS clouds often offer additional resources such as a virtual-machine disk image library, raw (block) and file-based storage, firewalls, load balancers, IP addresses, virtual local area networks (VLANs), and software bundles. IaaS-cloud providers supply these resources on-demand from their large pools installed in data centers. For wide-area connectivity, customers can use either the Internet or carrier clouds (dedicated virtual private networks). In this model, the cloud user patches and maintains the operating systems and the application software. Cloud providers typically bill IaaS services on a utility computing basis: cost reflects the amount of resources allocated and consumed. Cloud communications and cloud telephony, rather than replacing local computing infrastructure, replace local telecommunications infrastructure with Voice over IP and other off-site Internet services.

### Platform as a service (PaaS)

In the PaaS model, cloud providers deliver a computing platform, typically including operating system, programming language execution environment, database, and web server. Application developers can develop and run their software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers. With some PaaS offers (like Windows Azure, the underlying computer and storage resources scale automatically to match application demand so that the cloud user does not have to allocate resources manually.

### Software as a service (SaaS)

In the business model using software as a service (SaaS), users are provided access to application software and databases. Cloud providers manage the infrastructure and platforms that run the applications. SaaS is sometimes referred to as "on-demand software" and is usually priced on a pay-per-use basis. SaaS providers generally price applications using a subscription fee. In the SaaS model, cloud providers install and operate application software in the cloud and cloud users access the software from cloud clients. Cloud users do not manage the cloud infrastructure and platform where the application runs. This eliminates the need to install and run the application on the cloud user's own computers, which simplifies maintenance and support. Cloud applications are different from other applications in their scalability—which can be achieved by cloning tasks onto multiple virtual machines at run-time to meet changing work demand. Load balancers distribute the work over the set of virtual machines. This process is transparent to the cloud user, who sees only a single access point. To accommodate a



large number of cloud users, cloud applications can be *multitenant*, that is, any machine serves more than one cloud user organization. It is common to refer to special types of cloud based application software with a similar naming convention: desktop as a service, business process as a service, test environment as a service, communication as a service. The pricing model for SaaS applications is typically a monthly or yearly flat fee per user,<sup>1</sup>so price is scalable and adjustable if users are added or removed at any point. Proponents claim SaaS allows a business the potential to reduce IT operational costs by outsourcing hardware and software maintenance and support to the cloud provider. This enables the business to reallocate IT operations costs away from hardware/software spending and personnel expenses, towards meeting other goals.

### Network as a service (NaaS)

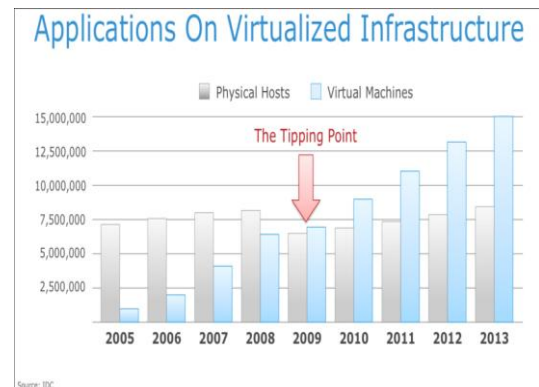
A category of cloud services where the capability provided to the cloud service user is to use network/transport connectivity services and/or inter-cloud network connectivity services. NaaS involves the optimization of resource allocations by considering network and computing resources as a unified whole. Traditional NaaS services include flexible and extended VPN, and bandwidth on demand. NaaS concept materialization also includes the provision of a virtual network service by the owners of the network infrastructure to a third party (VNP – VNO).

The popularity of the term can be attributed to its use in marketing to sell hosted services in the sense of application service provisioning that run client server software on a remote location. Cloud computing is a systems architecture model for Internet-based computing. It is the development and use of computer technology on the Internet. The *cloud* is a metaphor for the Internet based on how the internet is described in computer network diagrams; which means it is an abstraction hiding the complex infrastructure of the internet. It is a style of computing in which IT-related capabilities are provided “as a service”, allowing users to access technology-enabled services from the Internet (“in the cloud”) without knowledge of, or control over the technologies behind these servers. According to a paper published by *IEEE Internet Computing* in 2008 “Cloud Computing is a paradigm in which information is permanently stored in servers on the Internet and cached temporarily on clients that include computers, laptops, handhelds, sensors, etc.”. For example, Google Apps provides common business applications online that are accessed from a web browser, while the software and data are stored on the Internet servers.

## III. FACTS ABOUT CLOUD COMPUTING

The benefits of cloud are obvious. Here are a few important numbers that CIOs should pay close attention to:

- Cloud computing is increased drastically to 15 Million Virtual Machines in 2013 from less than 1 Million Virtual Machines in 2005.
- \$131 billion Estimated global cloud services market by the end of 2013
- \$180 billion Estimated global cloud services market by the end of 2015
- 50 million Number of physical servers in the world
- 84% CIOs who cut application costs by moving to the cloud
- 80% CIOs who get at least some of their infrastructure delivered through a private cloud
- 60% Server workloads that will be virtualized in 2013
- 60% CIOs who indicate that cloud computing is their top priority
- 48% Percentage of the cloud market spent on advertising in 2012
- 47.3% Expected growth of global IaaS market in 2013, to \$9 billion
- 27% State and local governments that implemented cloud services in 2012



For example, by 2014, 60% of server workload will be virtualized, meaning more businesses will be utilizing cloud services. Of all the cloud computing revenues, about 50% comes from the US and currently, 40% of the customer relationship management (CRM) systems sold globally are cloud-based. Additionally, IT organizations in 30% of Global 1000 companies will likely broker two or more cloud services for internal and external users by 2014. That is up from today's current figure of 5%. A quick glance at the infographic shows that the market size of Enterprise Cloud Based Services will increase from \$18.3 billion in 2012 to \$31.9 billion

in 2017; the SaaS Applications and Services market will rise from \$27 billion in 2012 to \$67 billion in 2016; and the Public Cloud Storage market will increase from a 2012 figure of \$5.6 billion to \$12.2 billion in 2016. Still considered in its infancy, these figures for cloud computing industry will only continue to increase as more businesses understand its potential. Cloud vendors are experiencing growth rates of 90% per annum.

#### IV. ADVANTAGES OF CLOUD COMPUTING IN AGRICULTURE

- Data management: The data will be managed by the service provider, a team of professionals. That guarantees a better and organized management of data.
- Data readiness: This provides data from the e-data bank databases to its entire stakeholder at any time and at any location throughout the year on 24x7x365 basis.
- 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 India is rural-urban migration. It can be reduced as this provides its services all over the state and may also all over country at any time no matter how remote the place is. This will also help in controlling unemployment problem in country.
- Motivation: It will motivate farmers & researchers to get involved more and more into agriculture as any communication will be result oriented. It will result in overall development of sector in the nation.
- Security: It provides an enhanced security as the resources will be stored in cloud and will be maintained centrally by the service providers. Thus, it is not a cause of concern for its users.
- Reduction of technical issues: It cuts short the man power, maintenance and infrastructure requirement drastically, as it will be provided by the service providers.
- Overall economy: Implementation of cloud computing in agriculture sector will help in uplifting the agricultural sector of the country. That will boost the overall development of the economy. It is due to the mass involvement of different stakeholders, as the system will monitor and deliver progress report whenever and wherever needed.

Cloud computing relies on sharing of resources to achieve coherence and economies of scale, similar to a utility over a network. This approach should maximize the use of computing powers thus reducing environmental damage as well since less power, air conditioning, rackspace, etc. is required for a variety of functions. The term "moving to cloud" also refers to an organization moving away from a traditional CAPEX model (buy the dedicated hardware and depreciate it over a period of time) to the OPEX model (use a shared cloud infrastructure and pay as you use it). Cloud computing allows enterprises to get their applications up and running faster, with improved manageability and less maintenance, and enables IT to more rapidly adjust resources to meet fluctuating and unpredictable business demand.

#### V. DISADVANTAGES OF CLOUD COMPUTING AND CHALLENGES

One of the main concerns of cloud computing is the conflict in different country laws. It demands a careful selection of the provider and may also require negotiation in drawing an effective agreement between the service providers. 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 reliable and reputed cloud service providers. One more important constraint is, cloud computing demands high speed and bandwidth of internet connectivity. The current national internet speed of India is 100 Mbps, which is just sufficient to cater the basic needs of India only, for entire India more than 1200Mbps speed is needed. For optimally use the cloud services in India needs much higher bandwidth than the current capacity. Companies using public clouds do not have ownership of the equipment hosting the cloud environment, and because the environment is not contained within their own networks, public cloud customers don't have full visibility or control. Capacity management is a challenge for both public and private cloud environments because end users have the ability to deploy applications using self-service portals.

Chargeback—or, pricing resource use on a granular basis—is a challenge for both public and private cloud environments. Chargeback is a challenge for public cloud service providers because they must price their services competitively while still creating profit. For private cloud operators, chargeback is fairly straightforward, but the challenge lies in guessing how to allocate resources as closely as possible to actual resource usage to achieve the greatest operational efficiency. Exceeding budgets can be a risk. Hybrid cloud environments, which combine public and private cloud services, sometimes with traditional infrastructure elements, present their own set of management challenges. These include security concerns if sensitive data lands on public cloud servers, budget concerns around overuse of storage or bandwidth and proliferation of mismanaged images. Managing the information flow in a hybrid cloud environment is also a significant challenge. On-premises clouds must share information with applications hosted off-premises by public cloud

providers, and this information may change constantly. Hybrid cloud environments also typically include a complex mix of policies, permissions and limits that must be managed consistently across both public and private clouds.

## VI. CLOUD COMPUTING IN AGRICULTURAL DEVELOPMENT

The applications of cloud computing technology in agriculture can solve the bottleneck problem of agricultural modernization and agricultural information, and can also break agricultural producers' limitations in knowledge or technology, reduce duplication, improve utilization of existing resources to make up for dispersed, small-scale, regional differences agricultural production and the strong dependence on the natural climate vulnerability of agricultural production. Modernizations of agriculture include three aspects:

- 1) Widely use modern agriculture production equipment, agricultural machinery;
- 2) Extensively use modern agricultural planting and breeding technology, weather observation and forecasting;
- 3) Use modern forms of production organization and management methods, etc.

There are many outstanding issues in technology and management, such as fewer agricultural technology service organizations and personnel, less necessary technical guidance, especially in the breeding, pollution-free crop cultivation and livestock breeding, soil testing, fertilizer, irrigation and soil improvement, meteorological observations and weather forecast were not enough technical support, most of farmers are in a state of blind conformity. Organizational form of production in agriculture is relatively simple, backward, and a low degree of specialization of agricultural production areas, it is difficult to achieve Integrating Agriculture. In addition, due to the limitations of the farmers at market forecasting, business decision-making, information gathering and logistics management capacity is more lacking; it often leads to a mismatch between the supply and demand, not only damages the farmers' own interests, have also hindered the healthy development of the market supply and demand. To meet the demand of information to the farmers in India, cloud computing information management will serve their information needs.

## VII. CONCLUSIONS

The implementation of cloud computing in agriculture must be in an efficient way, such that data which will be saved in cloud should be safe, easy to be fetched, cost should be minimized. To find this, we have observed some back draws of cloud computing. If it will possible to set up the cloud storage centrally, then the end users will be more beneficiary. The Indian agricultural sector is benefitting significantly by implementing cloud computing in agricultural sector properly. An effective implementation will lead to optimal benefit of shifting towards better advancement in the agricultural sector. This will definitely have a positive impact in the overall economic development of the rural India. Therefore, it needs a mass awareness and promotion among the prime stakeholders to acquire the full potential of it and have a well established information base. With the emergence of cloud computing as the paradigm in which scientific computing is done exclusively on resources leased only when needed from big data centers, e-scientists are faced with a new platform option. The cloud is insufficient for scientific computing at large, though it still appeals to the scientists that need resources immediately. The problem in cloud computing is data security in cloud data storage, which is essentially a distributed storage system. To achieve the assurances of cloud data integrity and availability and enforce the quality of dependable cloud storage service for users, we propose an effective and flexible distributed scheme with explicit dynamic data support, including block update, delete, and append. To meet demands of information to farmers of India, cloud computing information management will serve their information needs.

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