# CLOUD COMPUTING ISSUES, CHALLENGES, ARCHITECTURE, PLATFORMS, ANDAPPLICATIONS

Dr. Mahesh Sharma,[1] Dr. Seema Nath Jain [1]
IQAC Coordinator, Associate Professor, Ideal Institute of Management & Technology, [1] Karkardooma, Delhi – 110092.
HoD & Associate Professor, Ideal Institute of Management & Technology, [2] Karkardooma,Delhi – 110092.

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**Abstract:**

*Cloud computing refers to the emergence of parallel computing, distributed computing, grid computing, and virtualization technologies that define the shape of a new era. Cloud computing is a new commercial computing model that is gaining traction. In this paper, the concept of cloud architecture is discussed, as well as a comparison between cloud and grid computing. We also go over some of the most popular cloud computing systems' capabilities and applications. The goal of this study is to identify the obstacles and issues associated with cloud computing. From the standpoint of cloud computing adoption, we discovered many problems, as well as the cloud interoperability issue, which warrants additional investigation. Due to confidentiality issues, users, on the other hand, have considerable obstacles in adopting to cloud computing platforms. We investigate the security and privacy concerns of key cloud computing system providers in this study.*
**Keywords:** *SaaS, PaaS, IaaS, DaaS*

## 1. INTRODUCTIOn

Cloud computing is a relatively new idea. Virtualization, utility computing, software- as-a-service (SaaS), infrastructure-as-a-service (IaaS), and platform-as-a-service are all merging and progressing (PaaS). The phrase "cloud" refers to an online environment in which computing has been pre-installed and is provided as a service; data, operating systems, apps, storage, and processing power are all accessible via the internet and ready to be shared. Customers can quickly access pooled IT resources through the Internet with cloud computing, which is an on demand alternative. WhereIT resources like as networks, servers, storage, applications, and services can be quickly and easily implemented with little administration and service providerinteractions. In terms of improving theavailability of IT resources, cloud computing has a number of advantages over traditional computer platforms. Users can pay according to the demand for IT infrastructure, saving money on the cost of purchasing idle physical resources.

## 2. ARCHITECTURAL COMPONENTS

The rest of the paper is organised as follows:The architectural components Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS),and Data as a Service are all outlined inSection II (DaaS). Then, in Section III, we compare cloud and grid computing, followed by a discussion of various popular cloud computing systems in Section IV. In Section V, we shall discuss a

few cloud computing applications. We went over the difficulties and challenges of cloud computing in further depth in Sections VI, VII, and VIII. Finally, we reach the end of Section IX.



Fig. 1. The Cloud Architecture (Reference)

a. **Software as a Service (SaaS)**

Consumers of the cloud publish their programmes in a hosting environment that application users can access via a variety of clients over networks (e.g., a web browser, aPDA, etc.). Cloud users have no control overthe cloud infrastructure, which frequently employs a multi-tenancy system architecture, in which multiple cloud users' applications are grouped together in a single logical environment in the SaaS cloud toachieve economies of scale and optimizationin terms of speed, security, availability, disaster recovery, and maintenance. Examples include SalesForce.com, GoogleMail, Google Docs, and other SaaS apps.

b. **Platform as a Service (PaaS)**

PaaS (Platform as a Service) is a cloud- based development platform that covers the whole "Software Lifecycle," allowing cloud customers to construct cloud services andapplications (such as SaaS) directly on the PaaS cloud. As a result, the difference between SaaS and PaaS is that SaaS only hosts finished cloud applications, but PaaS hosts both.

There are two types of cloud applications: those that have been completed and those that are currently in development. In addition to enabling application hosting environments, PaaS must have development infrastructure, which includes programming environments, tools, configuration management, and so on. PaaS is exemplifiedby Google AppEngine.

c. **Infrastructure as a Service (IaaS)**

Customers of the IaaS cloud have direct access to the cloud's IT infrastructure (processing, storage, networks, and other basic computer resources). In the IaaS cloud,virtualization is commonly used to ad hoc integrate/decompose physical resources to meet changing resource needs from cloud customers. The primary principle of virtualization is to build self-contained virtual machines (VMs) that are isolated from both underlying hardware and other VMs. This method varies from the multi-tenancy paradigm, which aims to modify theapplication software architecture such thatmany instances (from different cloud users) can run the same application (i.e. the same logic machine). Amazon's EC2 is an example of IaaS.

d. **Data as a Service (DaaS)**

Virtualized on-demand storage is now available as a separate Cloud service called data storage. DaaS is a subclass of IaaS,which is worth highlighting. Because on- premise enterprise database solutions are typically connected with expensive upfront expenses such as a dedicated server, software licence, post-delivery services, and in-house IT maintenance, this is the case.Instead of paying for a full database licence, DaaS allows clients to pay just for what theyuse. In addition to standard storage interfaces like RDBMS and file systems, some DaaS providers provide table-style abstractions that scale out to store and retrieve massive amounts of data in a short amount of time, which is often too vast, too expensive, or too sluggish for mostcommercial RDBMS. This form of DaaS includes Amazon S3, Google BigTable, and Apache HBase.

## 3. DIFFERENCE BETWEEN CLOUD & GRID COMPUTING

1) Grids are built to perform a specific purpose, such as biology grids, geography grids, and national educational grids,whereas Cloud computing is developed for generic applications and does not includegrids for certain fields.

2) In order to construct a virtual organization, Grid lays a major emphasis on "resource sharing." Clouds are often owned by a single physical organization (with the exception of community clouds, which are owned by the community), which distributesresources to different running instances.

3) Grid computing pools resources to provide the highest processing capacity for ahuge task. Cloud aims to meet as many small-to-medium task requirements as possible, depending on the demands of usersin real time. As a result, Cloud computing's multi-tenancy is a critical problem.

4) Grid strikes a balance between reusability and high-performance (scientific) computation. The need for cloud computing is driven by immediate user needs, which are motivated by a number of business goals.

5) Grid computing aims for the highest possible computer performance. On-demandcomputing is what cloud computing is all about: scaling up and down, in and out while optimizing total processing capability.

## 4. SOME CLOUD COMPUTING SOFTWARES/PLATFORMS (POPULAR ONES)

### I. AbiCloud

Abicloud is a cloud computing framework for building, integrating, and managing public and private clouds in heterogeneous contexts. Abicloud allows users to deployand manage servers, storage systems,networks, virtual devices, and applications quickly and easily. Abicloud differs fromrest of the cloud computing platforms in twoways: its sophisticated cloud – based management function and its core encapsulation method. By dragging a virtualmachine with the mouse, a user can complete the deployment of a new service using Abicloud. This is far more convenient and adaptable than other cloud computing systems that use command lines to deploy new services.

Abicloud can be used to install and implement private and hybrid clouds based on the needs and configurations of the cloud providers. It can also administer EC2 in accordance with protocol regulations.

Furthermore, with Abicloud that is a whole cloud platform built on Abicloud may becompressed and re-deployed on any otherAbicloud platform. This will make the clouddeployment procedure much easier and flexible, and will help with the change of theworking environment.

### II. Eucalyptus

The open-source private cloud platformEucalyptus (Elastic Utility Computing Architecture for Linking Your Programs to Useful Systems) was mostly used. Eucalyptus is an open-source infrastructure that may be used to join users' applications to beneficial systems. It is a flexible, efficacy, cloud computing and a popular computing standard based on a service level protocol that allows users to lease network for processing capability.

Eucalyptus is now compatible with Amazon's EC2, and with minor modificationand extension, it may be able to support a wider range of customers.

### III. Nimbus

Nimbus is a suite of open tools as well as a cloud computing service that offers IaaS. It allows customers to rent remote resources and create the necessary computing environment by deploying virtual machines.

All of these functional components can be divided into three categories. Client- supported modules, for example, are used to support a variety of cloud clients. This category includes context client modules, cloud client modules, reference client modules, and EC2 client modules. Thesecond type of component consists primarilyof cloud platform service-supported modulesthat provide a variety of cloud services. Context agent, web service resource framework, EC2 WSDL, and remote interface modules are all included. The background resource management modules, which include work service management module, IaaS gateway module, EC2 and other cloud platform support module,workspace pilot module, workspace resource management module, and workspace controller, are the third type of component.

### IV. OpenNebula

OpenNebula is a cloud service framework that is also open source. It helps users to deploy and operate virtual machines on real resources, as well as transform their datacentres or clusters into flexible virtual infrastructure that can adapt to changing service loads automatically. The key difference between OpenNebula and nimbusis that the latter one has a remote edge basedon Amazon's EC2 or WSRF that allows users to process all security-related issues, whereas OpenNebula does not. OpenNebula is also an open and flexible virtual infrastructure management tool that can be used to synchronise storage, network, andvirtual techniques, as well as allowing users to dynamically deploy services on distributed infrastructure based on data centre and remote cloud resource allocation strategies. Users can easily deploy any form of cloud using the interior interfaces and OpenNebula data centre infrastructure.

Table 1. Difference table: Cloud ComputingServer Platforms

| | **Abicloud** | **Eucalyptus** | **Nimbus** | **OpenNebula** |
|---|---|---|---|---|
| Cloud Character | Public/private | Public | Public | Private |

| Scalability | Scalable | Scalable | Scalable | Dynamic, Scalable |
|---|---|---|---|---|
| Clouds form | IaaS | IaaS | IaaS | IaaS |
| Compatibility | Not support EC2 | Support EC2, S3 | Support EC2 | Open, multi-platform |
| Deployment | Pack and redeploy | Dynamical deployment | Dynamical deployment | Dynamical deployment |
| Deployment Manner | Web interfacedrags | Command line | Command line | Command line |
| Transplant-ability | Easy | Common | Common | Common |
| VM support | Virtual Box, Xen, VMware, VM | Xen, VMware, KVM | Xen | Xen, VMware |
| Web interface | Libvirt | Web service | EC2, WSDL, WSRF | libvirt, OCCI, EC2,API |
| Structure | Open platform encapsulates core | Module | Lightweight components | Module |
| Reliability | - | - | - | Rollback host andVM |
| OS support | Linux | Linux | Linux | Linux |
| Development language | Ruby, c++, python | Java | Java, python | Java |

## V. Applications

The following are some examples of cloudcomputing applications:

1) A stable and secure data storage centre isprovided by cloud computing.

2) Cloud computing enables data sharingacross various devices.

3) The cloud gives consumers a practically limitless number of ways to access the internet.

4) Cloud mechanism does not require the user to have high-quality equipment and is simple to utilize.

## VI. Cloud Computing Issues

As and when, more and more information about individuals and businesses is stored in the Cloud Space; questions regarding its security are beginning to arise. Cloud computing issues can be summarized as follows:

### A. Privacy

Users' personal data may be spread across numerous virtual data centres rather than staying in the same physical location when using cloud computing services, and users may spill concealed information

while usingcloud mechanism services. Invaders can examine the dangerous task based on thecomputing task that users have supplied.

B. **Reliability**

The cloud servers, like our local server, havedowntimes and slowdowns.

C. **Legal Concerns**

Concerns about personal safety and secrecy persist all the way up to legislative levels.

D. **Compliance**

Regular reporting and audit trails are required by several standards controlling data storage and use. Cloud providers' data centres may be subject to additional compliance obligations in addition to the rules that apply to clients.

E. **Freedom**

Cloud mechanism prevents end-users from directly possessing data storage, insteadentrusting data storage and control to cloud providers.

F. **Long-term viability**

You should be certain that the data you save in the cloud will never become invalid, evenif your cloud computing provider goesbankrupt or is acquired and swallowed up bya larger corporation.

G. **Cloud Interoperability Issues**

**Layer 1: Intermediary**

Many recent efforts have focused on interoperability by acting as a middlemanbetween cloud customers and cloud-specific services. (e.g. VM).

2) **Open Standardization**

The interoperability problem looks to be amenable to open standardisation. The interoperability issue hasn't been high on thepriority list of significant commercial cloud vendors at a time when cloud computing is just getting started.

3) **Open API**

The Sun Open Cloud Platform was just introduced by SUN under the CreativeCommons attribution-noncommercial-noncommercial-noncommercial-n Theproposed (in-progress) cloud API is a major contribution of this platform. It specifies a collection of simple and intuitive RESTful Web services interfaces that allow cloud users to generate and administer cloud resources, such as computing, storage space,and networking gears, in a united manner.

4) **Interoperability between PaaS & SaaS**

While the already discussed solutions mostly address IaaS interoperability challenges, SaaS interoperability typically covers a wide range of application domains, including ERP, CRM, and other business applications. A group of data mining expertstackles the subject of developing a cloud- based data mining standard, focusing on "the practical application of statistical methods, trustworthy model production deployment, and the integration ofpredictive analytics" across various data mining-based SaaS clouds. Interoperability of PaaS is yet to be discovered. It would be more difficult to achieve uniformity in the way consumers develop and deploy cloudapplications because PaaS encompasses the whole software development life-cycle onthe cloud.

## VII. Difficulties in Cloud Adoption from aperception (according to IDC)

A. Distinguished security issues like data failure, phishing, and botnets (a collection of machines that run remotely) pose major hazards to an organization's records and software. Cloud computing's multi-tenancy model and joint computing resources have presented new protection concerns, such as resources (hard drive, records, and virtual machines) on the same system, which invitesunanticipated side conduit between amalevolent resource and a regular source. Furthermore, the matter of

"reputation fate-sharing" will severely harm the reputation of nice Cloud "citizens" who, unhappily,allocate computing resources with a notorious user with a criminal mind as a fellow tenant. Because they mayshare the same network address, any bad behaviour will be attributed toall users, regardless of whether they are true subverters or not.

### B. Costing Model

Cloud users must weigh the benefits and drawbacks of computing, communiqué, and incorporation. While moving to the Cloud may save money on infrastructure, it alsoincreases the charge of data connectivity.

### C. Charging Model

The flexible resource band (through virtualization or multitenancy) has made expenditure scrutiny much more challengingfor cloud providers than for traditional data centres, which frequently calculate costs based on use of static computation.

### D. Service Level Agreement (SLA)

It's critical for customers to attain service delivery assurance from suppliers. These areusually offered through SLAs that are conferred between suppliers and consumers.

## VIII. Privacy & Security Issues

Cloud computing's immense scalability allows it to provide endless computing resources on demand, removing the need forcloud service providers to plan ahead forhardware delivery. Many companies, like Amazon, Google, Microsoft, and others, are accelerating the development of cloud computing systems and upgrading theirservices in order to reach a bigger audience.

This study looks into the security and privacy vulnerabilities of existing cloud computing platforms offered by a number ofcompanies. Cloud computing encompassesboth the applications offered as services over the Internet and the infrastructures (i.e.,the hardware and systems software in data centres) that support them.

According to the analysis, today's security and privacy issues given by businesses are insufficient, posing a significant barrier to customers' adoption of cloud computing platforms. As a result, extra security concerns, such as accessibility, privacy, datareliability, organize, and assessment, should be considered.

## A. On-demand security

Cloud services are programmes that run on cloud computing infrastructures and areaccessible via an internal network or the Internet. Cloud computing enables providersto create, deploy, and run applications that can readily scale in capacity (scalability),work quickly (performance), and never (or seldom) fail (reliability), all without having to worry about the qualities or locations of the underlying infrastructures.

Together, cloud computing platforms can accomplish the following five objectives:

### 1) Accessibility

The goal of cloud computing (including apps and infrastructures) availability is toallow users to access them at any time and from any location. Due to its web-native nature, cloud computing allows users to access the system (e.g., apps, services) from anywhere. This holds true for any cloud computing platform (e.g., DaaS, SaaS, PaaS,IaaS, and etc.). Because it is necessary to be utilised at all times, the cloud computingsystem should be available to all users at all times (say it is scalable for any number of users). Hardening and redundancy are two typical methods for increasing the availability of cloud systems or applications hosted on them.

### 2) Confidentiality

It refers to keeping user data private in cloudservices. Physical isolation and encryption are the two basic ways for achieving such confidentiality, and both are commonly employ ed by cloud computing providers.

### 3) Data security

In the context of a cloud system, the word "information integrity" refers to the preservation of data integrity (i.e., not lost ormodified by unauthorised users). Data integrity is crucial since data is the cornerstone for cloud computing services like Data as a Service, Software as a Service, and Platform as a Service.

### 4) Control

Control refers to the capability to controlhow the system, including the applications, infrastructure, and data, is utilized in a cloudmechanism.

### 5) Audit

It implies to keep an eye on what's going on in the Cloud mechanism. Audits could be implemented as a layer to the virtualized process structure housed on the virtual device to allow for monitoring of system activity. Because it can monitor the full access time, it is far more secure than that which is embedded into the programmes or software itself.

## IX. Conclusion

The architecture and common platforms of cloud computing were addressed in this study. It also went over the challenges and issues of cloud computing in great depth.Cloud computing is becoming a very enticing paradigm, particularly for large enterprises, despite its limitations and theneed for updated procedures and processes.

Cloud mechanism projects, which have the potential to fundamentally revolutionize IT, could have an impact on businesses within two to three years.

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