Cloud Computing and its Applications: A Review

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Cloud Computing and its Applications: A Review

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Abstract
Cloud computing, also on-demand computing, is a kind of Internet-based computing that provides shared processing resources and data to computers and other devices on demand.[1] [2]. The term cloud computing refers to accessing services or information from third party data centers remotely over the Internet from any location. Cloud computing networks access to a shared pool of configurable networks, servers, storage, service, applications & other important Computing resources. The main aim of this paper is to explore the various applications areas of cloud computing and provides an overview of the field, where the Cloud Computing are used and discusses the critical role of cloud computing played in different areas such as small & large scale (manufacturing, automation, television, broadcast, constructions industries), Geographical Information system (GIS), Military intelligence fusion (MIF), business management, banking, Education, healthcare, Agriculture sector, E-Governance, project planning, cloud computing in family etc.

Keywords: Cloud computing, community model, hybrid model, Public model, private model, Applications of cloud computing.

1. INTRODUCTION

Nowadays, with the rapid growth of cloud computing, many industries are going to move their computing activities to clouds. Cloud computing is the provision of computer or IT infrastructure through the Internet. That is the provisioning of shared resources, software, applications and services over the internet to meet the elastic demand of the customer with minimum effort or interaction with the service provider. It is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [1]. The cloud computing-based high-performance computing center aims to solve the following problems:

- High-performance computing platform generated dynamically
- Virtualized computing resources
- High-performance computer management technology combined with tradition ones
- High-performance computing platform generated dynamically

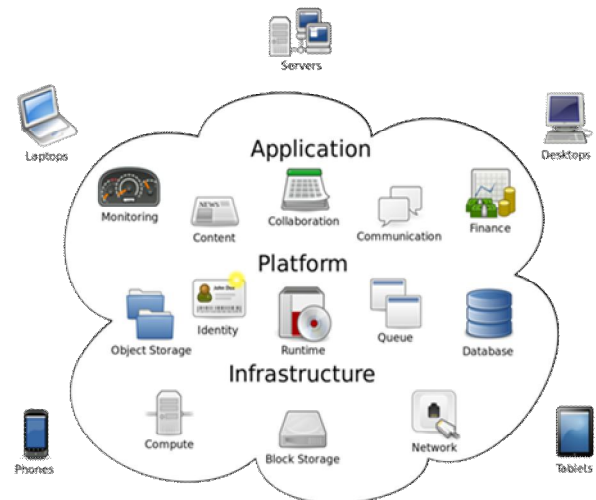Different phase of cloud computing description table-1 & showing figure-2. [1] [3]
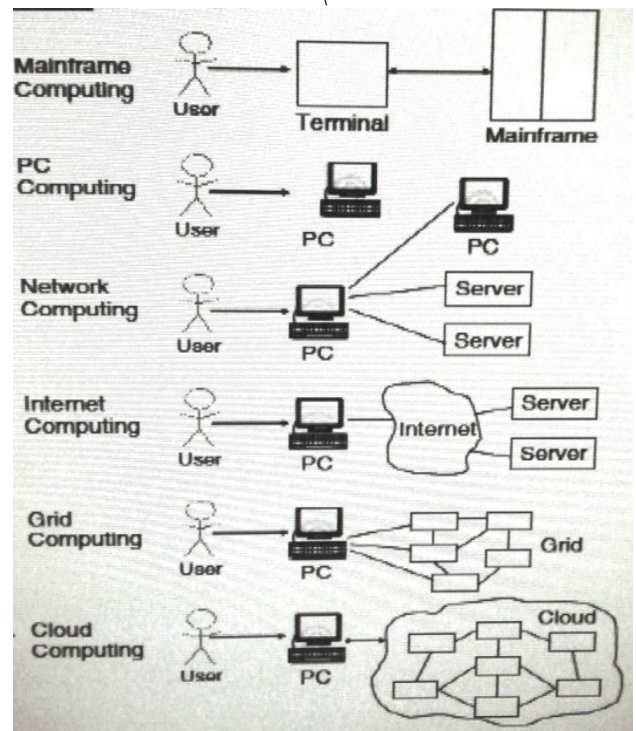

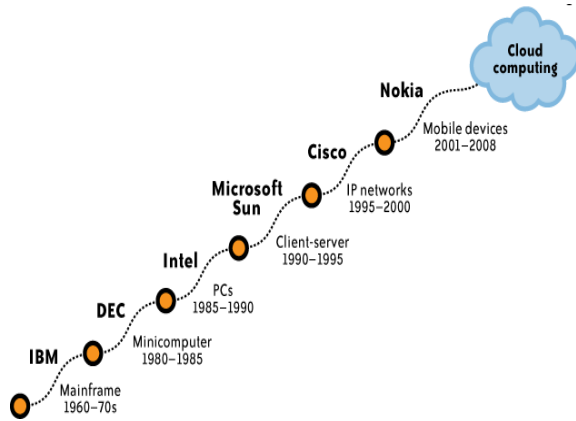**Fig.1** Cloud computing

Fig.2 Evolution of Cloud Computing-1

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Fig.3 Evolution of Cloud Computing-2

Table-1 Different phases of cloud computing

Phase	Descriptions
1.Mainframes 1950s	• Users shared powerful mainframes using dummy terminals • Start of automation phase • Localized Infrastructure
2.PC Computing 1960s	• Stand-alone PCs became powerful enough to meet the majority of users needs • Rise in Demand of personnel Computer • Decentralized Computing • Birth of IT service
3.Network Computing 1990s	• PCs, laptops and servers were connected together through local networks to share resources and increase performance.
4.Internet Computing 2001	• Local networks were connected to other local networks forming a global network such as the Internet to utilize remote applications and resources.
5.Grid Computing 2010	• Computing provided shared computing power and storage through a distributed computing. • Solving large problems with parallel computing
6.Cloud Computing beyond 2010	• Cloud computing is the provision of computer or IT infrastructure through the Internet. That is the provisioning of shared

	resources, software, applications and services over the internet to meet the elastic demand of the customer with minimum effort or interaction with the service provider.

Table-2 Advantages & Disadvantages of Cloud computing

S.No.	Advantage of cloud computing
1.	Back up recovery is very easy in Infrastructure as a service (IaaS) provider; hence there is efficient incident response whenever data need to be recovered.
2.	In addition to the IT industry, even small scale business can adopt this environment (model)
3.	Considering cloud computing from the aspects of power management, it serves as a virtual server which is easy to implement as compare to physical servers. Hardware management failure can also be localized and rectified with relative ease
4.	Reduced setup costs can be considered as a major advantage for cloud computing ,Since the cost involved in setting up a data centre are not very high.
5.	Various data centres are spread throughout the country and thus it make easy for business to Use preferred sites.
6.	The assessment of data can be done a time and is highly beneficial for the IT industry in reducing the workloads
7.	Automatic Software Integration
8.	Easy Access to Information: Once you register yourself in the cloud, you can access the information from anywhere, where there is an Internet connection.
9.	Almost Unlimited Storage
Sl.No.	Disadvantages of Cloud Computing
1.	A major disadvantage in cloud computing is that it is under the maintenance and supervision of a third -party. Hence the confidentiality and security measures are less secured.
2.	In cloud environment the data is not specifically segregated. It is distributed throughout the cloud network and causes the problems when specific data needs to be segregated.
3.	The Quality of service is a key determining factor in the efficiency of a cloud network.

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	A reliable service provider providing desired quality of service may be difficult to source and the process set-up could turn out to be time consuming.
4.	Another major drawback is the dependence on network connectivity .Network failure can result in loss to the company by causing extensive time delays
5.	Storing information in the cloud could make your company vulnerable to external hack attacks and threats. As you are well aware, nothing on the Internet is completely secure and hence, there is always the lurking possibility of stealth of Sensitive data.

2Deployment Model of Cloud Computing
Cloud computing can be deployed in four different ways: private cloud, public cloud, community cloud, hybrid cloud – combination of both public and private.[1] [4] [10]

2.1 Private cloud
The private cloud represents a model where a single organizations stand up cloud capacity and only the member of organizations are allowed to consume the capacity. This is a common model for government and large enterprise private cloud is good in security concern; it may exit on premise or off premise. Example- eBay

Fig.4 private Cloud

2.2 Public (General) clouds
The cloud infrastructure is available to general public. It's a cloud that anyone can use like google, amazon. Public cloud implementations are large cloud .
Example: Amazon, Google Apps, Windows Azure.

Fig. 5 Public Cloud

2.3 Community (domain specific) clouds
These clouds are maintained for specific requirements by a group of organizations. It is computing resources provided over the internet for restricted use by a specific community of users from organizations that have shared interest. Usually the users are a group of people with a common background or with shared concerns within the community or society. Community clouds are an intermediary between private and public clouds. It may be managed and operated by one or more of the organizations in the specific community, a third party, or some combination of them, and it may exist on or off premises.

Fig.6 Community Cloud

2.4 Hybrid cloud (Mixed model)
The Hybrid cloud are combination of two or more cloud model (private, community, public) that remain unique entity but are bound together by standardized technology that enable data and application portability. Cloud infrastructures aimed at achieving ultimate cost reduction through outsourcing while maintaining the desired level of control. According Examples: Google, Amazon, Windows Azure

Fig.7 Hybrid Cloud

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3. CLOUD SERVICE MODEL

A cloud based architecture can be defined as a set of resources - hardware and software, which combine together to deliver the aspects of computing as a service. Services in such a scenario are charged on a usage based pricing model and the users are no longer required to care about the intricacies which are needed to be taken care in a traditional on-premise computing model.
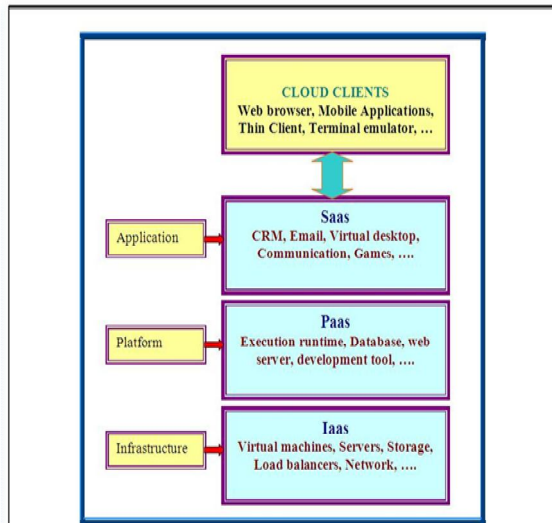

Fig.8 Cloud service Model

Table-3 Difference between IaaS, PaaS and SaaS

Service type	IaaS	PaaS	SaaS
1. Service category	VM Rental, Online	Online Operating Environment, Online Database, Online Message Queue	Application and
	Storage		Software Rental
2. Service Customization	Server Template	Logic Resource Template	Application Template
3. Service Provisioning Service accessing and Using	Automation Remote Console, Web 2.0	Automation Online Development & Debugging, Integration of Offline Development Tools & Cloud	Automation Web 2.0
4. Service monitoring	Physical Resource Monitoring Dynamic	Logic Resource Monitoring Dynamic	Application Monitoring Dynamic
5.Service level management	Orchestration of Physical Resources	Orchestration of Logic Resources	Orchestration of Application
6. Service resource optimization	Network Virtualization, Server Virtualization, Storage Virtualization	Large-scale Distributed File System, Database, Middleware etc	Multi-tenancy

4. Application of Cloud Computing

4.1 Cloud computing system in education

Once any of the computer system connected with internet gets started then it will directed the student, teacher or in better words a whole institute to the cloud. In cloud both the students and teachers have to login with their separate id and from here the first best feature that is to monitor attendance of teacher and student is possible, secondly Live and recorded both type of the lectures can be seen by the student. The best part of this facility is that a student studying at any school and another student studying at any big name school both are attending the same tutorial from a highly skilled faculty at the same time. Thirdly entire examination process is changed and now the exams will be conducted on cloud and the results of each and every exam that is even a class test is reported directly to the concerned authority [5]. With this new system parents can be able to monitor their ward attendance and his growth in the session. This new system also helps the students to prepare well for the upcoming competitive exams like NTSE, IIT JEE, AIEEE, PET, and PMT etc and stop the fashion of joining big coaching and spending their parents hard earned income. Main Advantages of Cloud computing in Education are listed in the below, [6]

- Teleconferencing & Distance learning
- hybrid classes (online & off-campus learning)
- Acquiring and implementing the latest software and application updates.
- Streamlining enrollment and admissions processes that are costly and time-consuming.
- Offering schools, colleges, universities and others a low cost option for using high concept computing systems. All that's needed is an internet connection which is low cost.
- Sharing work without having to use paper. Using paper is costly both to the environment and in monetary terms and is therefore no longer a viable way to educate.
- Removing the admin burden allows educational facilities to concentrate on their core business and be more productive .IT admin including licensing issues, software updates and IT security management will all be taken care of by Cloud provider.
- Storing confidential and critical data centrally in the cloud, which is less prone to exposure threats such as the loss or theft of laptops or USB flash drives.
- Allowing free access applications and Updating stock of information.
- Higher quality of education delivered anytime anywhere: Courses with updated content can b delivered consistently across all locations.
- Leveraging on limited staff or teachers, a university can reach out to numerous students all across the globe, hence limiting the costs of education delivery.
- Scalable systems on cloud to provision big data platform for research and analysis.
- Courses delivered over cloud through a central

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location will lead to a standard content delivery to multiple remote virtual classrooms.

- Students and teachers can collaborate on studies, projects using collaboration solutions.

4.2 Cloud computing in healthcare

The healthcare industry has been leveraging technological innovations for decades to provide superior quality services to patients. Medical technology-based devices and equipments such as Computed Tomography (CT) Scanners, Diagnostic Sonographic Scanners, Magnetic Resonance Imaging (MRI) Scanner, remote monitoring devices, health and wellness-check devices etc. have helped in diagnosing health problems eliminating the need of expensive and hazardous surgeries. In healthcare provisioning process, once the patient is admitted into the hospital and his details are entered in the Hospital Management Information System (HMIS) the process of diagnosis begins. Now let us consider scenario when doctors are standing in demand side, he wants to access information about patient from Hospital Management Information System. Doctor will consult to admin of HMIS and admin will reply with complete information about patient. In the process, the doctor might take expert advice as and when required. And cloud expert will reply with expert advice. Cloud computing technologies allow the remote monitoring of a patient's Heartbeat data, its analysis in minimum time, and the notification of first-aid personnel. This way a patient at risk can be constantly monitored without going to hospital. Most important advantages of cloud computing in healthcare. [15]

- Online health monitoring system hosted in the cloud
- Patient care can be improved by providing this service through the cloud faster and more efficiently
- The cloud offers providers the ability to access specific experts to manage and maintain their systems
- Healthcare providers are in the business of treating and caring for patients.
- Health information Exchange (HIE) between the physicians, hospitals & other health care organization
- The evaluation & Adoption of Technologies that allow physician to remotely visit patient via video conference.
- A clinical Information System (CIS) allows healthcare providers to schedule & order lab test, quickly access test results, send prescription directly to the pharmacy & manage all the critical notes from the doctors & specialists without unnecessary double data entry.
- Health care data security is improved.
- Electronic Medical Records (EMR): Hospitals & physicians are starting to see cloud based medical records & medical images achieving services coming on line.
- Telemedicine has grown to include not only tele-consultations & tele surgeries, but also health record

Exchange, Video-Conferencing & home monitoring.

4.3. Manufacturing and Automation

The Cloud could increase productivity, quality, efficiency, flexibility, and versatility of almost all automation systems. Below is a list of potential benefits:

A. Allow manufacturing and automation as services over the cloud
- Facilitate small shops bidding on jobs and also let shops rent out idle equipment
- Reduce design and prototype time
- Better connection to consumers and suppliers

A. Personalized and customized products
- Commodity v/s branding, online user reviews and feedback systems enable small businesses to quickly establish themselves.
- Enabling new technologies such as 3D printing and mobile phones
- In medical markets, fashion items (e.g. shoes, eyeglasses)

B. Production capacity / resources sharing
- Higher utilization of the equipment
- Reduction of capital investment
- Easier management

C. Optimized complexity
- Better managing increased globalization and complexity
- Reduced impact on quality due to complex manufacturing network

D. Subscription-based pricing model which ensures that organizations pay only for the capacity that they require and for the time they need.

4.4 Mechanical Engineering

Mechanical design platform software in engineering Cloud that is used in Particular product development. This mechanical Design Platform software is based on virtual product software (VPS) technology. VPS technology allows the user to quickly & easily use 3D data throughout data overall life cycle of the product. VPS has been provided to users inside & outside the company & received favorably as a user friendly tool that allows the Mechanical 3D data.

4.5 GIS applications

Geographic Information System (GIS) is used for taking high quality satellite photos. These photos have rising requirement. These high quality photos needed computational power and high quality data storage.[9]

4.6. Military intelligence fusion (MIF)

MIF is the process of military intelligence data fusion. MIF as a process of adjusting, combining and incorporating the information and data from multi-source into a uniform expression to obtain accurate target position, state estimation, identity validation. Using cloud

computing it offer dynamic accessing intelligence resource pool.

4.7 Television and broadcast industry
Cloud computing will become the core technologies in the tri-network integration and the next generation of broadcasting television network.

4.8 Field of Power Engineering
Moscow Power Engineering Institute (MPEI) makes an on-line calculation server for an engineer which is contains tables on specific volume, enthalpy, entropy, isobaric tension, dynamic viscosity, thermal conductivity etc. which is easily accessible on-line.

4.9 Banking Sector
Using of cloud computing in banking sector gets more beneficial compare to traditional network. Cloud computing provide centralized server for the employer and customer. Cloud computing sole the software problem to install in each computer for any application software and manage individual computer. Advantages of Cloud Computing in the banking sector listed in the below. [13] [14]

- No need for heavy investments in new hardware and software.
- Cost saving & usages-based billing
- Achieve higher level of data protection, disaster recovery & fault tolerance
- Cloud is available on-demand; less infrastructure investments are required, saving initial set-up time.

4.10 E-Governance
E-Governance is a process of government work, share information & deliver services to the client. Various types of E-Governance applications are as follows

Government to Government (G2G): Various types of functions of the government interact to fulfill the work. Administration, inter governance enterprise and control monitor and distribution etc.

Government to Enterprise (G2E): Enterprises like water board, electricity are controlled by the governments and should react quickly to government policies.

Government to Business (G2B): Government interacts with various business activity such as collection of taxes, contract management etc.

Government to Consumer (G2C): Government provides numerous services to their citizens.

4.11 Construction Industry
The construction industry balances back-office functions—billing, paying invoices, running financial reports, payroll, planning logistics—with the physical presence needed on the job site or in a client's office. Today's technological solutions must be able to serve

users in both work settings. As a result, making mission - critical business applications available remotely is a hot topic these days. Remote access allows staff to work from any location without being tied to a specific physical location. With the amount of consolidation, decentralization of offices, travel-based positions, and project work being done in different regions of the country or even internationally, being able to offer solid remote access technology to employees is critical for a construction company's success. With web-based tools for time capture, project management, and service management for general contractors, subcontractors, and owners, Sage will deliver a comprehensive cloud– based solution to address the evolving construction management needs of our customers.

4.12. Project Planning
Project management is the act of planning, organizing, & managing resource to bring about the successful completion of specific project objectives. Project participants involve different types of work & different location. Naturally, a web-based application lets participants from different locations access the same master files. Users can access files from any internet-connected computer using any web browser.

4.13 Agriculture sector
In spite of the various ICT projects in India, the country is still facing various challenges: Lack of awareness among farmers about the benefits of ICT in agriculture.

- Deficient production information.
- Inadequate knowledge about the weather forecast, threats from pests and diseases.

Cloud computing is going to solve these challenges .By using the cloud technology, farmers have nothing to worry about hardware and software investments and also the technical knowledge to learn them [11] [12] . Farmer as client need to send a request to the service provider and by thorough analysis of request, result will be passed back to the client. Cloud computing will give on demand opportunities through which data sharing and data collection is possible, which is very crucial for agricultural research and development. This technology can offer a centralized knowledge database which can be used to store all the agriculture related information. [16] [17]

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

- Prediction of weather and related knowledge database.
- Database for crop related information.
- Database for market related information.
- Database for production related data.

Farmers can also post their problems seeking for solutions from the expert .With the help of mobile phone applications farmers can instantly contribute to the knowledge database by uploading crop and soil related information, pictures, videos and any other information.

5. Conclusions

Cloud computing is an emerging technology which can bring revolutionary changes in the usage of internet. Cloud computing is a combination of various computing technologies and it can play a major role in bringing significant improvement in data transfer and communication. This paper provides a basic understanding of cloud computing which includes the cloud model, types of clouds, services, issue & applications. This paper also elaborates the recent trends in cloud computing. Future work aims at understanding the basic technologies involved in cloud computing.

6.Future Research Areas

Although much progress has already been made in cloud computing, I believe there are a number of research areas that still need to be explored. Issues of security, reliability, and performance should be addressed to meet the specific requirements of different organizations, infrastructures, and functions.

- Expand to small and medium sized companies applications
- Reliability
- Vulnerability to attacks
- Data Security improvement
- Cluster distribution
- Network optimization
- Interoperability

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