Cloud Computing: Basic Concepts, Characteristics and Services Providers

* Bassam Ali M. Almamari, Research Scholar, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, India

I. INTRODUCTION

Cloud computing is a technology that relies on the transfer of processing and data storage for the so-called the cloud, which is a server to be accessed via the Internet, Thus the Information Technology resources provided as a service instead of Products. Cloud Computing can be defined as new style of computing in which dynamically scalable and often virtualized resources are provided as a service over the Internet. Cloud Computing has become a significant technology trend, and many experts expect the cloud computing will reshape Information Technology (IT) processes and the IT marketplace. With the cloud computing technology, users uses a variety of devices, including PCs, laptops, smartphones, and PDA's to access programs, storage and application-development platforms over the Internet, via services offered by cloud computing providers. Advantages of the cloud computing technology include cost savings, high availability and easy scalability [1, 2].

Cloud computing is the result of evolution and adoption of existing technologies and paradigms. The goal of cloud computing is to allow users to take benefits from all of these technologies, without the need for deep knowledge about or expertise with each one of them. The cloud aims to cut costs, and help the users focus on their core business instead of being impeded by IT obstacles [3, 4]. According to the definition of NIST, Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable 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. Cloud computing as the latest trend in the realm of Information Technology and has gained a major attention during the last couple of years. Cloud computing enables users to utilize different services without the knowledge or control over the technology infrastructure which supports them. Hence it can be literally named as the service is "on the cloud" [5, 6].

Fig. 1 a Cloud Computing Environment

1. CLOUD COMPUTING ARCHITECTURE

Cloud computing architecture refers to the components and subcomponents required for cloud computing. These components typically consist of a front end platform (fat client, thin client, mobile device), back end platforms (servers, storage), a cloud based delivery, and a network (Internet, Intranet, Intercloud). Combined, these components make up cloud computing architecture [**7**].

I. CLOUD COMPUTING CHARACTERISTICS

In this section we describe the essential characteristics and other characteristics.

I. Essential Characteristics:

In this subsection we describe the essential characteristics that a cloud must possess. Any cloud is expected to have these five Essential characteristics (according to NIST) that are being described below

A. *On-demand self-service*

A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service's provider.

B. *Broad network access*

Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and personal digital assistants (PDAs)).

C. *Resource pooling*

The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the subscriber generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or data centre). Examples of resources include storage, processing, memory, network bandwidth, and virtual machines.

D. *Rapid elasticity*

Capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.

E. *Measured Service*

Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported providing transparency for both the provider and consumer of the utilized service.

II. Other Characteristics

Cloud computing exhibits the following key characteristics:

➢ **Agility** improves with users' ability to re-provision technological infrastructure resources.

➢ **Cost** reductions claimed by cloud providers. A public-cloud delivery model converts capital expenditure to operational expenditure. This purportedly lowers barriers to entry, as infrastructure is typically provided by a third party and does not need to be

purchased for one-time or infrequent intensive computing tasks. Pricing on a utility computing basis is fine-grained, with usage-based options and fewer IT skills are required for implementation (in-house). The e-FISCAL project's state-of-the-art repository contains several articles looking into cost aspects in more detail, most of them concluding that costs savings depend on the type of activities supported and the type of infrastructure available in-house.

➢ **Device and location independence** enables users to access systems using a web browser regardless of their location or what device they use (e.g., PC, mobile phone). As infrastructure is off-site (typically provided by a third-party) and accessed via the Internet, users can connect from anywhere.

➢ **Maintenance** of cloud computing applications is easier, because they do not need to be installed on each user's computer and can be accessed from different places.

➢ **Multitenancy** enables sharing of resources and costs across a large pool of users thus allowing for:

• **Centralization** of infrastructure in locations with lower costs (such as real estate, electricity, etc.)

• **Peak-load capacity** increases (users need not engineer for highest possible load-levels)

• **Utilization and efficiency** improvements for systems that are often only 10–20% utilized.

➢ **Performance** is monitored and consistent and loosely coupled architectures are constructed using web services as the system interface.

➢ **Productivity** may be increased when multiple users can work on the same data simultaneously, rather than waiting for it to be saved and emailed. Time may be saved as information does not need to be re-entered when fields are matched, nor do users need to install application software upgrades to their computer.

➢ **Reliability** improves with the use of multiple redundant sites, which makes well-designed cloud computing suitable for business continuity and disaster recovery.

➢ **Scalability** and elasticity via dynamic ("on-demand") provisioning of resources on a fine-grained, self-service basis in near real-time (Note, the VM startup time varies by VM type, location, OS and cloud providers, without users having to engineer for peak loads.

➢ **Easy Access to Information**. Once the users register in the cloud, they can access the information from anywhere, where there is an Internet connection. This convenient feature lets users move beyond time zone and geographic location issues.

➢ **Backup and Recovery**. Since all the data is stored in the cloud, backing it up and restoring the same is relatively much easier than storing the same on a physical device. Furthermore, most cloud service providers are usually competent enough to handle recovery of information. Hence, this makes the entire process of backup and recovery much simpler than other traditional methods of data storage.

II. CLOUD SERVICE MODELS

This section describes the various cloud delivery models. Cloud can be delivered in 3 models namely SaaS, PaaS, and IaaS.

❖ Software-as-a-Service (SaaS):

In a cloud-computing environment, SaaS is software that is owned, delivered and managed remotely by one or more providers and that is offered in a pay-per-use manner [8, 9]. SaaS in simple terms can be defined as "Software deployed as a hosted service and accessed over

the Internet." [9, 10] .SaaS clouds provide scalability and also shifts significant burdens from subscribers to providers, resulting in a number of opportunities for greater efficiency and, in some cases, performance. The typical user of a SaaS offering usually has neither knowledge nor control about the underlying infrastructure [11].

❖ B. PLATFORM-AS-A-SERVICE (PAAS):

This kind of cloud computing provides development environment as a service. The consumer can use the middleman's equipment to develop his own program and deliver it to the users through Internet and servers. The consumer controls the applications that run in the environment, but does not control the operating system, hardware or network infrastructure on which they are running. The platform is typically an application framework. 4.3.

❖ Infrastructure-as-a-Service (IaaS):

Infrastructure as a service delivers a platform virtualization outsourced service. The consumer can control the environment as a service. Rather than purchasing servers, software, data center space or network equipment, consumers instead buy those resources as a fully operating system, storage, deployed applications and possibly networking components such as firewalls and load balancers, but not the cloud infrastructure beneath them.
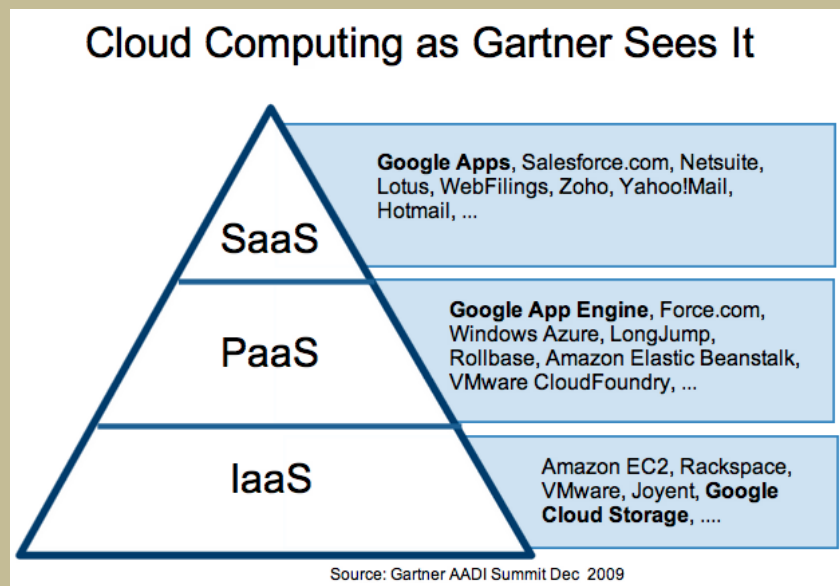
Fig. 2 a Cloud Service Models

III.   CLOUD COMPUTING DEPLOYMENT MODELS

❖ Public Cloud

This cloud infrastructure is available to the general public or enterprise.

1- The cloud infrastructure is provisioned for open use by the general public
2- It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them
3- It exists on the premises of the cloud provider.
4- A flexible option to save costs and reduce risks.

❖ Private Cloud

The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units).

1- It may be owned, managed, and operated by the organization, a third party, or some combination of them.

2- It may exist on or off premises.

❖ Community Cloud

The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy and compliance considerations).

1. It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them.

2. It may exist on or off premises

❖ Hybrid Cloud

The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).
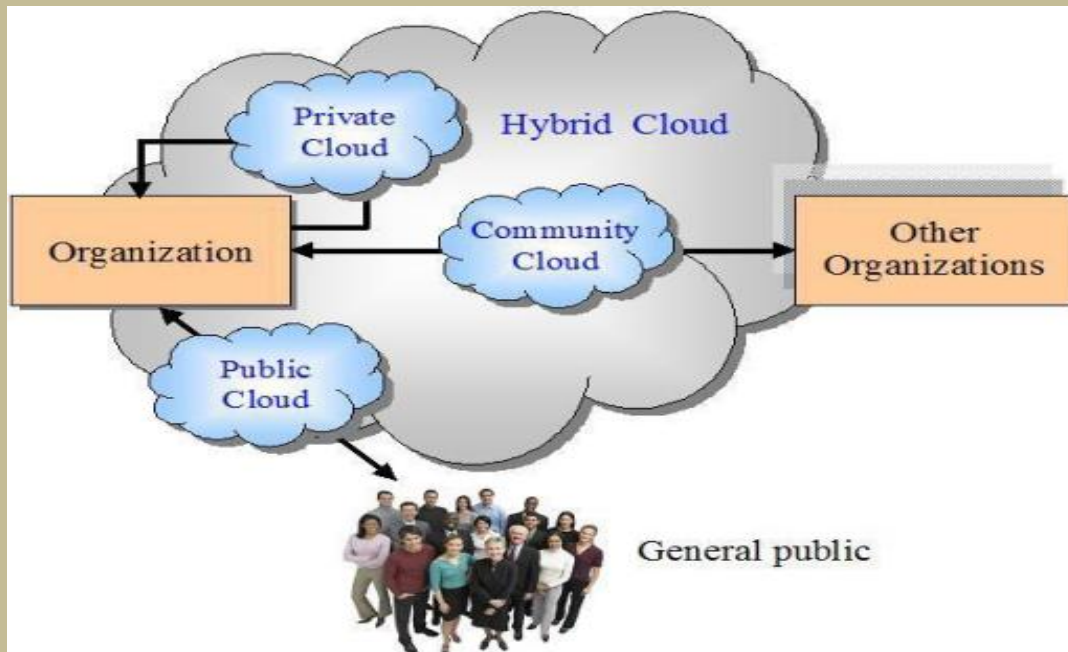
Fig. 3 a Cloud Deployment Models

IV.   DRAWBACKS OF CLOUD COMPUTING

In spite of its many benefits, as mentioned above, Cloud computing also has its disadvantages. Businesses, especially smaller ones, need to be aware of these aspects before going in for this technology. The main risks involved in Cloud Computing are:

➢ **Technical Issues**. Though it is true that information and data on the Cloud can be accessed any time and from anywhere, there are moments when the system can have some serious malfunction. Businesses should be aware of the fact that this technology is always prone to outages and other technical issues.   Even the best Cloud service providers run into this kind of trouble, in spite of keeping up high standards of maintenance.

➢ **Security in the Cloud**. The other major issue of Cloud is represented by security. Before adopting this technology, beneficiaries should know that they will be

surrendering all their company's sensitive information to a third-party cloud service provider. This could potentially impose a great risk to the company. Hence, businesses need to make sure that they choose the most reliable service provider, who will keep their information totally secure. Switching to the cloud can actually improve security for a small business, as mentioned by Michael Redding, managing director of Accenture Technology Labs. "Because large cloud computing companies have more resources, he says, they are often able to offer levels of security an average small business may not be able to afford implementing on its own servers" (Outsource IT Headaches to the Cloud (The Globe and Mail)).

➢ **Prone to attack**. Storing information in the cloud could make the companies vulnerable to external hack attacks and threats; therefore there is always the lurking possibility of stealth of sensitive data.

➢ **Possible downtime**. Cloud computing makes the small business dependent on the reliability of their Internet connection.

➢ **Cost**. At first glance, a cloud computing application may appear to be a lot cheaper than a particular software solution installed and run in-house. Still, the companies need to ensure that the cloud applications have all the features that the software does and if not, to identify which are the missing features important to them. A total cost comparison is also required. While many cloud computer vendors present themselves as utility-based providers, claiming that they only charge for what customers use, Gartner says that this isn't true; in most cases, a company must commit to a predetermined contract independent of actual use. Companies need to look closely at the pricing plans and details for each application.

➢ **Inflexibility**. Choosing a Cloud computing vendor often means locking the business into using their proprietary applications or formats. For instance, it is not possible to insert a document created in another application into a Google Docs spreadsheet. Furthermore, a company needs to be able to add and/or subtract Cloud computing users as necessary as its business grows or contracts.

➢ **Lack of support**. Anita Campbell (OPEN Forum) writes, "Customer service for Web apps leaves a lot to be desired - all too many cloud-based applications make it difficult to get customer service promptly – or at all. Sending an email and hoping for a response within 48 hours is not an acceptable way for most of us to run a business".

The New York Times writes: "The bottom line: If you need handholding or if you are not comfortable trying to find advice on user forums, the cloud probably is not ideal" Thinking about Moving to the Cloud? There Are Trade-Offs.

V. MOST A KNOWN CLOUD COMPUTING VENDORS

❖ **Amazon Elastic Compute Cloud (EC2).** is a central part of Amazon.com's cloud computing platform, Amazon Web Services (AWS). EC2 allows users to rent virtual computers on which to run their own computer applications. EC2 allows scalable deployment of applications by providing a Web service through which a user can boot an Amazon Machine Image to create a virtual machine, which Amazon calls an "instance", containing any software desired. A user can create, launch, and terminate server instances as needed, paying by the hour for active servers, hence the term "elastic". EC2 provides users with control over the geographical location of instances that allows for latency optimization and high levels of redundancy [12].

❖ **Rackspace Inc**. is an application hosting (Web Application Hosting), providing a platform cloud (cloud sites) on the network, which is based on the basis of utility computing, also provides file cloud storage and its infrastructure (cloud servers).

❖ **Vmware.** One of the main pillars in the virtual infrastructure and cloud computing.

❖ **GoGrid.** is a cloud infrastructure service, hosting Linux and Windows virtual machines managed by a multi-server control panel and a RESTful API[13].

❖ **Salesforce.** is a global cloud computing company headquartered in San Francisco, California. Though best known for its customer relationship management (CRM) product, Salesforce has also expanded into commercial applications of social networking through acquisition [14].

❖ **Google Cloud Platform** is a cloud computing platform by Google that offers hosting on the same supporting infrastructure that Google uses internally for end-user products like Google Search and YouTube.[15] Cloud Platform provides developer products to build a range of programs from simple websites to complex applications.[16][17]. Google Cloud Platform is a part of a suite of enterprise solutions from Google for Work and provides a set of modular cloud-based services with a host of development tools. For example hosting and computing, cloud storage, data storage, translations APIs and prediction APIs. [18]

❖ **Microsoft Azure**. Is a cloud computing platform and infrastructure, created by Microsoft, for building, deploying and managing applications and services through a global network of Microsoft-managed datacenters. It provides both PaaS and IaaS services and supports many different programming languages, tools and frameworks, including both Microsoft-specific and third-party software and systems. Azure was released on 1 February 2010. [19].

Fig. 4 Cloud Computing Providers

VI. CONCLUSION

In this paper we've looked at the basics concepts of cloud Computing, giving some different of definitions from the view of different experts, Information technology Research institutes, business organizations and cloud Providers. Also we have gone through the characteristics of cloud computing in which we have divided them into two groups, first group shows the essentials characteristics that must be considered, and another group shows other characteristics.

In fact, above of all mentioned characteristics there are two important points have to take into consideration, without them there will not be possible to access the cloud. Those points are Internet access and availability of cloud service. If there is no internet service in your device, company or your device is out of internet access range area, that means it is not possible to get connected to your cloud services. Also if there are some technical problems or any other problems with the cloud service provided to you i.e. no access possible to cloud, this may create a problem for your business. Hence these two requirements must take them into consideration before get started shifting into cloud computing system. we have discussed the cloud service and deployment models, also cloud computing Architecture that explain how cloud could work.

Lastly we have discussed the drawbacks of cloud computing and some examples of most known Cloud Providers. this paper can give general information about cloud computing basics for those who are interested to know about cloud computing.

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