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A Study on Fundamentals of Cloud Computing

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Abstract: ***Cloud computing technology has become very popular in the IT industry and expecting a new extension for coming world .For companies like Google and Microsoft go towards the resources as when they need. It reduces the time required to get heavy resources, boot new server instances in minutes and it allow users dynamically scalable through a variety of programmatic interfaces. Cloud computing is based on several other computing research areas such as High Performance Computing(HPC), virtualization, utility computing and grid computing. In this paper we presented the essential and common characteristics of cloud computing, benefits and challenges.***

Keywords: Cloud Computing, Public, Private, Hybrid, Community, SaaS, PaaS and IaaS.

I. INTRODUCTION

Cloud computing is a set of resources that are offered to the users through the network. Here the term cloud represents internet or network. Cloud computing is one of the most popular technology in recent trends. The users can use any application or software which is available in cloud without the need of installing, thereby reducing the cost and storage space. Cloud computing involves a centralized server which is going to store all the needed resources, and any number of clients can access the cloud to fetch the needed resource. Beside the web email, the Amazon Elastic Compute Cloud (EC2), Google App Engine and Sales force's CRM largely represent a promising conceptual foundation of cloud services. These services are broadly classified into three categories: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS)[7].

Cloud computing features can change entire computing world where entire applications, installations, data storage of every individual can be stored in cloud storage servers without using any memory of the local computer. Data stored in cloud servers can be visible from all over the world with this feature complexity of data accessing will be reduced. Cloud computing can reduce cost for companies, One any software is installed in cloud it can be accessible by company officials from all over the world with this feature there is no further investment for buying multiple software's. Companies need to just invest on cloud storage.

II. CLOUD COMPUTING

Nowadays, every body and every IT company is discussing about the cloud computing. Though there is no precise definition about cloud computing, we can understand it in many ways. Cloud computing is a model for enabling universal, 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. The United States government is a major consumer of computer services and, therefore, one of the major users of cloud computing networks. The U.S. National Institute of Standards and Technology (NIST) has a set of working definitions that separate cloud computing into service models and deployment models. The following NIST Cloud Framework figure shows

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the relationship among deployment models, Service models, essential characteristics and common characteristics of cloud computing .

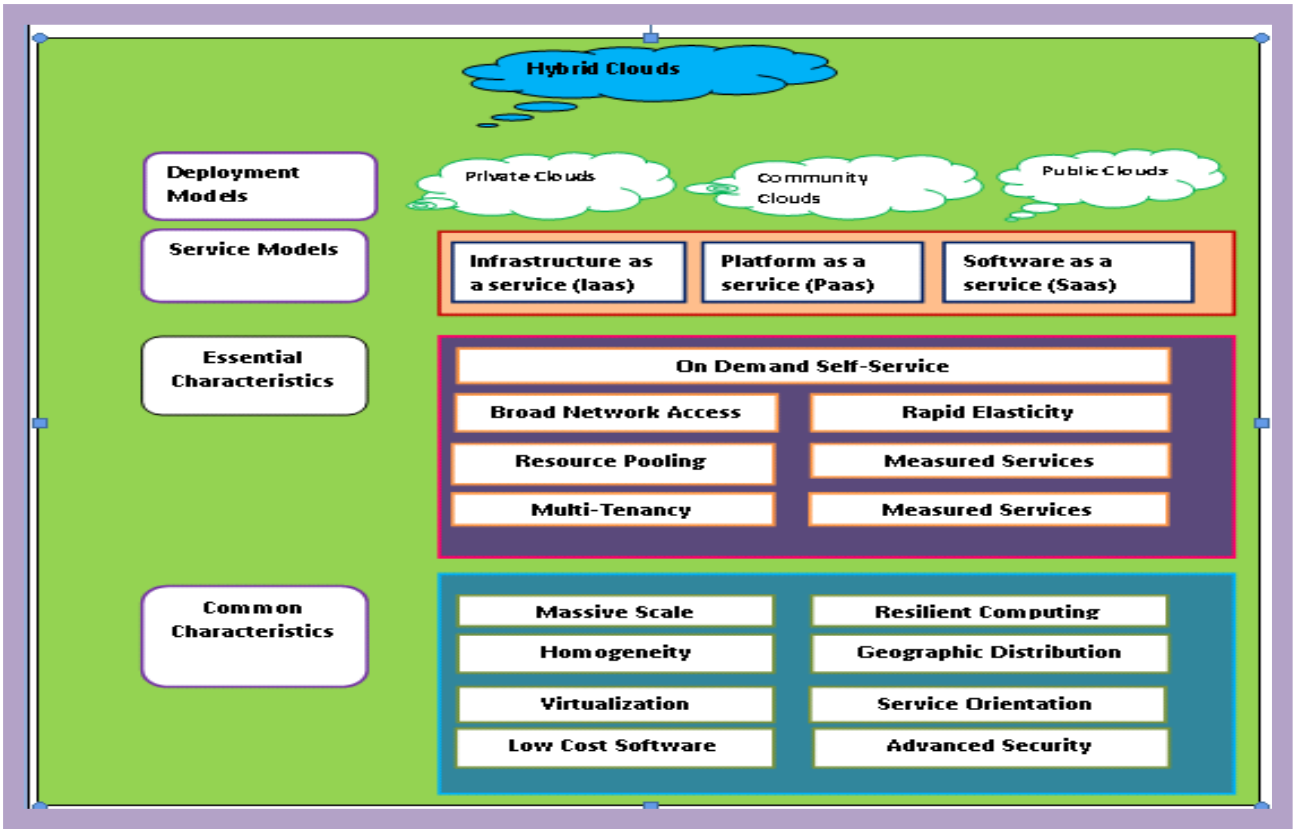

Figure: NIST CLOUD FRAMEWORK

2.1 Deployment Models

A deployment model defines the purpose of the cloud and the nature of how the cloud is located. The NIST definition for the four deployment models is as follows [1]

• **Public cloud:** The Public clouds accessible by the any paid user of the service and we built these clouds over the internet. This cloud providing by the service provider to the user with the user subscription. For example the various public clouds are Google App Engine (GAE), Amazon Web Services (AWS),Microsoft Azure, Salesforce.com's Force.com

• **Private cloud:** The private cloud allows the limited use of the resources by the clients and service workloads are run on administrative domains for the local users. Private clouds provide the better services than the public clouds which are efficient and convenient to the client. It is mainly under the control of organization and it has greater customization. For example the various Private clouds are: Eucalyptus, Elastra**,** VMware**,** and Microsoft.

• **Hybrid cloud:** Hybrid clouds are the combination of public and private clouds. Hybrid clouds allowing third party to access the resources. By interacting the public and private clouds, hybrid clouds perform distinct functions within the organization. For example Research Compute Cloud (RCL) is the private cloud that is constructed by IBM. It connects internally to compute the resources of IT at the eight IBM research center that can be done in United States, Europe and Asia.

• **Community cloud:** A community cloud is one where the cloud has been organized to serve a common function or purpose. It may be for one organization or for several organizations, but they share common concerns such as their mission, policies, security, regulatory compliance needs, and so on. A community cloud may be managed by the constituent organization(s) or by a third party. For example all Government organizations within the state of California may share computing infrastructure on the cloud to manage data related to citizens residing in California.

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2.2 Service Models :

Infrastructure-as-a-Service (Iaas)

Infrastructure-as-a-Service is the delivery of huge computing resources such as the capacity of processing, storage and network. Taking storage as an example, when a user use the storage service of cloud computing, he just pay the consuming part without buying any disks or even knowing nothing about the location of the data he deals with. Sometimes the IaaS is also called Hardware-as-a-Service (HaaS) [2,7]. Vendors that provide Infrastructure as a service are Amazon EC2, Amazon S3,Rackspace Cloud Servers and Flexi scale .

Pros of IaaS are as follow [1]:

- Multiple customers can access on a same hardware resources.
- Cost varies on depend on service.
- It provides the resources as a service.
- It allows dynamic scaling.

Platform-as-a-Service (Paas)

Platform-as-a-Service generally abstracts the infrastructures and supports a set of application program interface to cloud applications. It is the middle bridge between hardware and application. Because of the importance of platform, many big companies want to grasp the chance of pre-dominating the platform of cloud computing as Microsoft does in personal computer. The well known examples are Google App Engine and Microsoft's Azure Services Platform .

Pros of PaaS are as follow [1]:

- Pay per use
- No need of installing or downloading software for users.
- Concurrent users can access the application due to shared architecture.
- Provide same integrated platform for develop, deploy and test so it reduce development and maintenance cost.
- Provides reliability and security.

Software-as-a-Service (Saas)

Software-as-a-Service aims at replacing the applications running on PC. There is no need to install and run the special software on our computer if we use the SaaS. Instead of buying the software at a relative higher price, we just follow the pay-per-use pattern which can reduce the total cost. The concept of SaaS is attractive and some software runs well as cloud computing, but the delay of network is fatal to real time or half real time applications such as 3D online game.

Pros of SaaS are as follow [1]:

- Provides products for documenting online such as Microsoft office.
- Software available in for short term manner.
- Technique available for fast delivering the technology.
- Broad application of services available online such as face book, twitter, Hotmail etc.
- It uses programming interfaces which provide implementation between different Tools of software.

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2.3 Essential Characteristics

On demand services: A consumer can access the independent service computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service's provider.

Broad Network Access: Capabilities are available over the network and accessed through standard mechanisms that used by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and PDAs).less disk device.

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.

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 the consumer demand. There is a sense of location-independence in that the customer 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 center). Examples of resources include storage, processing, memory, network bandwidth, and virtual machines.

Measured Service: Cloud systems automatically control and optimize resource use by investing 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 managed, controlled, and reported providing transparency for both the provider and consumer of the utilized service[4].

Multi-tenancy: Users can access to multiple services provide by multiple service providers.

Maintenance: Cloud service providers maintain the cloud systems and services .

2.4 Common Characteristics: Apart from the above essential characteristics there are some more common characteristics exist they are:

Massive Scale: Massive systems can be constructed with the help of millions of computers that all connected to the edged networks. But these systems are highly scalable. It scales up the research activities.

Homogeneity: No matter which cloud provider and architecture an organization uses, an open cloud will make easy to work with other groups, even if those other groups choose different providers and architectures.

Virtualization: Virtualization is a technique, which allows us to share a single physical instance of a resource or an application among multiple customers and organizations. It does by assigning a logical name to a physical storage and providing a pointer to that physical resource when demanded. Some of the virtual resources are Hardware Virtualization, Operating System Virtualization, Server Virtualization and Storage Virtualization.

Low Cost Software: Cost reductions are claimed by cloud providers. A public-cloud delivery model converts capital expenditures (e.g., buying servers) to operational expenditure. This asserted lower barriers to entry, as infrastructure is typically provided by a third party and need not be purchased for one-time or infrequent intensive computing tasks. Pricing on a utility computing basis is "fine-grained", with usage-based billing options. As well, less in-house IT skills are required for implementation of projects that use cloud computing.

Resilient Computing: Cloud providers have mirrored solutions to minimize downtime in the event of a disaster. Resiliency can give businesses sustainability which is needed during the unanticipated events.

Geographic Distribution: Geographic Distribution is used to share the information among multiple systems which may also be in different locations. In geographically distributed system there is no single real point of failure. Geographical

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distributed database system consists of loosely coupled sites that share no physical components. Collections of data (e.g. in a database) can be distributed across multiple physical locations [8].

Service Orientation: Service orientation is a way to modularize key business services and to establish well-defined interfaces designed to ensure that these services work in many different situations. Cloud computing has adopted service orientation, but it certainly makes it easier to create a well-functioning cloud. As companies add more and more cloud services, the service-oriented approach becomes a more important.

Advanced Security: It provides the secure access to online resources are single sign on, Management of virtual organizations and by providing the secure data storage and transport.

III. CLOUD COMPUTING BENEFITS

Reduced operating cost: Cloud computing reduces the high cost of hardware and software. We can simply pay for the subscription-based models.

Flexibility: Cloud-based services are ideal for businesses with growing bandwidth demands. If our needs increase it's easy to scale up the cloud capacity.

Mobility: With cloud computing, if we have an internet connection we can able to work from any where. Now a days most of the cloud services offering mobile apps and we don't have any restrictions to operate the devices.

Disaster recovery: Cloud-based services provide quick data recovery for all kinds of emergency scenarios from natural disasters to power outages.

Reliability: With a managed service platform, cloud computing is much more reliable and consistent than in-house IT infrastructure. Most providers offer a Service Level Agreement which guarantees 99.99% availability. We can benefit from a massive pool of redundant IT resources, as well as quick failover mechanism - if a server fails, hosted applications and services can easily be transmitted to any of the available servers.

Improved Collaboration: Cloud applications improve collaboration by allowing dispersed groups of people to meet virtually and easily share information in real time and via shared storage.

IV. THE CHALLENGES OF CLOUD COMPUTING

Security & Privacy: The main challenge to cloud computing is how it addresses the security and privacy concerns of businesses thinking of adopting it. The fact that the valuable enterprise data will reside outside the corporate firewall raises serious concerns. **Hacking and various attacks** to cloud infrastructure would affect multiple clients even if only one site is attacked. These risks can be mitigated by using security applications, encrypted file systems, data loss software, and buying security hardware to track unusual behavior across servers[6].

Access to data: Cloud-based servers do not always have the most effective or appropriate customer service support systems. Integration is a problem for many organizations. Ensuring that all of the applications are able to seamlessly integrate with one another is also a common challenge[3].

Service delivery and billing: It is difficult to assess the costs involved due to the on-demand nature of the services. Budgeting and assessment of the cost will be very difficult unless the provider has some good and comparable benchmarks to offer. The service-level agreements (SLAs) of the provider are not adequate to guarantee the availability and scalability. Businesses will be reluctant to switch to cloud without a strong service quality guarantee[5].

Load balancing: Load balancing is one of the main challenge in cloud computing. It is a technique which is required to distribute the dynamic workload across multiple nodes to ensure that no single node is overloaded.

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Transition to the cloud: Transitioning to the cloud is a complex process. There is no single route to success. There are various ways the businesses can transition to the cloud. Whether it's via private, public or hybrid technologies, identifying the right service model for business is a vital step.

Vendor Lock-in: Even if we are already using the cloud we would like to have control over our data and be able to switch service providers freely. Ensuring data portability is essential, as is understanding the data ownership and retrieval policies of the provider.

Performance and Bandwidth Cost: Businesses can save money on system acquisitions, management and maintenance, but they may have to spend more for the bandwidth. For smaller applications this is not usually an issue, but cost can be high for the data-intensive applications. Delivering and receiving intensive and complex data over the network requires sufficient bandwidth to avoid atency and application time outs.

Lack of Skills, Knowledge and Expertise: It's different in the cloud, and many IT organizations may not have the necessary tools or resources to implement, monitor and manage cloud solutions. It's not what they are geared to do. Educating staff about new processes and tool sets, or hiring staff with new skills, may be necessary increasingly so as more of operations and applications move to the cloud over time. Selecting the right service provider will definitely help ease the transition and fill gaps.

V. CONCLUSION

In this paper, we have studied about cloud computing deployment models ,service models, essential and common characteristics, benefits and focused on challenges of cloud computing. Cloud computing technology is still evolving, we desire these work may give a much better knowledge of the challenges of cloud computing, and mark the way for more research in this domain.

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