



Cloud Computing: Overview & Comparison with Grid Computing

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Abstract— This paper presenting basic concept of cloud computing in which defining what is cloud computing, models of clouds, deployment types of cloud, challenges in cloud computing and features of cloud computing. We are presenting comparison of cloud computing with distributed computing and one of its form which is grid computing.

Keywords— Cloud, Cloud computing, Distributed computing, Grid Computing

I. INTRODUCTION

Today, Internet is the most popular technology and its usage is increasing over a period. In industry, institutes, organizations, offices, business, government sectors, and many other sectors are using internet while running their business. Pay-and-use concept is applied in various businesses. This similar concept is used in cloud computing where through internet infrastructure, platform and software can be provided by vendors as service. This helps users who can be businessman to start his business at low cost by getting platform or infrastructure as a service. Cloud computing environment do not require user’s high level equipment which reduces the user’s cost for overall business setup.

II. CLOUD COMPUTING

“Cloud computing is a model for enabling 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. This cloud model promotes availability and is composed of five essential characteristics, three service models, and four deployment models [1].”

Cloud computing is the model using which user can obtain access to storage spaces and computer resources available in the network. This service is provided by the cloud providers. It provides easy and affordable access to external computer resources through network.

Cloud: Accessing information from any system at any time is possible with the help of cloud. Internet facility is needed to access cloud in the network [2].

Traditional computer systems make you access your data and application from same physical location and system. The cloud computing takes over this and makes you to access your data from any system and from any location at any time. Through cloud computing it is possible to acquire computer resources over the Internet instead of storing data onto local storage devices [2]. Application oriented architecture of system increases cost of overall system where as Cloud computing is service oriented and not application oriented. Cloud computing is also referred as “Internet Computing” [3].

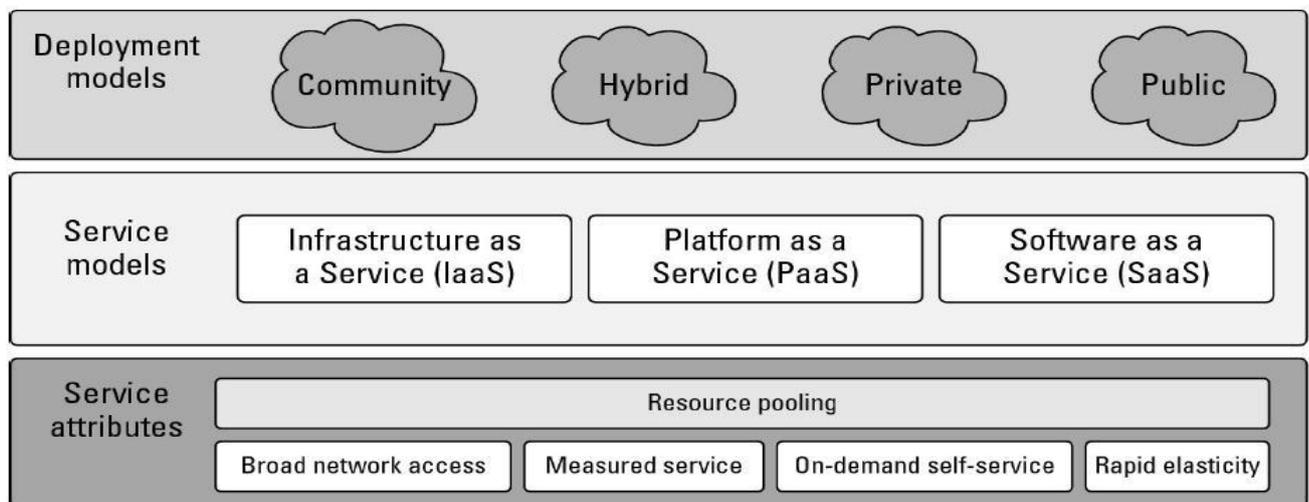


Figure1: NIST cloud computing definitions

Basic principle of cloud computing is assigning the computing task to multiple computers connected in network instead of performing on the local computers [4].

III. CHARACTERISTICS OF CLOUD

Essential definition of cloud computing listed by NIST are: on-demand self-service, broad network access, resource pooling, rapid elasticity or expansion, and measured service.

1. *On-demand self service*: In on-demand self service, services are provided by the vendors supplied to users on demand whenever they required. In cloud computing model also services provided by cloud service vendor are managed in such manner that the service are supplied whenever request send by customer [1]. It is important feature of cloud computing in which user scales required infrastructure without disrupting present operations of system

2. *Broad Network Access*: Broad Network Access refers access to resources hosted in private (within organization) cloud network. In private cloud, data need to be accessed within company's firewall due to security concern. But broad network access behaviour is opposite of private cloud. Organizations use outside public cloud to host server or use other cloud services which organization access for their employees. It is more common in hybrid cloud model but less used in private cloud model [2].

3. *Resource pooling*: A situation in cloud computing environment where service providers serve many users or clients with available and scalable services is termed as resource pooling [10]. In this, services are managed in such a way that each user's demand will be fulfilled without any frequent changes. To resource pooling strategy, kind of services applied are data storage services, processing services, virtual machines and bandwidth provided services [10].

4. *Rapid elasticity*: It is an ability to provide scalable services [10]. Due to setup of cloud computing services, service provision will be smooth for the user. Rapid elasticity characteristic of cloud computing allows quickly scale out and rapidly released to scale in. It allows users to automatically request additional space in the cloud and also request to other type of services [2].

5. *Measured service*: The cloud provider measures or monitors the provision of services for various reasons like effective use of resources, billing or overall planning [10]. For user and cloud service provider to get utilized service information, resources can be measured and monitored [2].

6. *Pay-per-use mode services*: Services are provided in pay-per-use mode through contract accepted by service level agreements (SLAs) between cloud service provider and user [3].

IV. CLOUD TYPES

Cloud Computing classified into different types based on:

- I. Cloud location with respect to access and security concern
- II. Services provided by cloud providers

Based on location of cloud user can subscribe to any type of cloud listed below:

1. *Public Cloud*: Public cloud is used or shared by more than one user or group of users which will be hosted by cloud service provider as well managed by the same service provider. Example: Amazon's EC2 (Elastic Compute Cloud) for high performance computing services, Google Doc, IBM's Blue Cloud [14], Sun Cloud

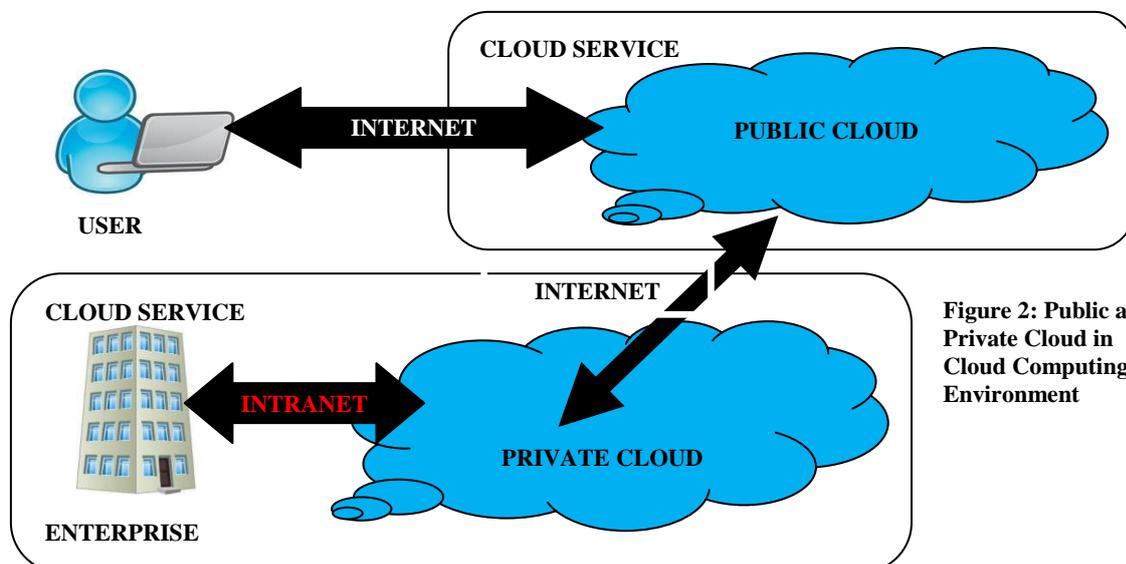


Figure 2: Public and Private Cloud in Cloud Computing Environment

2. *Private Cloud:* Private cloud is used by a single organization or single user which also will be hosted by cloud service provider. It is exclusively allocated for one user or organization. This kind of clouds can be managed, controlled in private data centers. It is also referred as enterprise or internal cloud. For example, private cloud used by Defense Information Systems Agency (DISA) and United States Department of Agriculture (USDA) [9]
3. *Community Cloud:* Community cloud is used by groups which have common shared interest, information. In this, infrastructure, software and hardware are shared between organizations. For example, in the state of California all government organizations sharing computing infrastructure on the cloud to access, manage data of citizens in California
4. *Hybrid Cloud:* Hybrid cloud is joint infrastructure of public and private cloud. Hybrid cloud used by organization who would like to host business-critical information or applications on private cloud for security concern and less critical applications on public cloud. For example,

V. CLOUD COMPUTING MODELS

Based on services provided by cloud service provider, cloud models are categorized into three models as given below:

1) *Infrastructure as a Service (IaaS):* In this cloud computing model, infrastructure facility such as hardware, server, disk storage, virtual servers, network components are offered instead of purchasing. Presently vendors providing this kind of cloud computing environment are Amazon EC2, Rackspace cloud servers and Amazon S3.

2) *Platform as a Service (PaaS):* This type of cloud computing model provides development platform on the cloud as a service. User can use service provider's equipment to develop its application or program. Application control is done by user but Operating System and infrastructure control is done by service provider. For example, Google Application Engine and Microsoft Azure [5].

3) *Software as a Service (SaaS):* In this model, complete software will be provided as a service to user. The software provided through this model is completely controlled, managed, and hosted by the providers remotely. Software applications accessed by user on pay-per-use basis. For example, Microsoft's online version of office called BPOS (Business Productivity Online Standard Suite) and Salesforce offering Customer Relationship Management (CRM) space in online mode.

"XaaS" stands for 'X as a Service' where X is software, hardware, platform, infrastructure, data, business etc. Based on this we have SaaS (Software as a Service), HaaS (Hardware as a Service), IaaS (Infrastructure as a Service), DaaS ([Development, Database, Desktop] as a Service), PaaS (Platform as a Service), BaaS (Business as a Service), FaaS (Framework as a Service), OaaS (Organization as a Service) etc. [5]

VI. CLOUD COMPUTING CHALLENGES

Overall challenges in cloud computing is listed below:

i. *Security:* Security is major challenge in present cloud computing models. This includes security of user data against security breaches [2], making sure that confidentiality of user data is maintained by cloud service provider. Third-parties are involved in cloud based system, here may services, data and information is shared and transferred between third-party and user. Data distributed across network on various servers and it is on the internet so easily accessible for other invalid users. So there is need of managing the data and information on cloud to increase believe of users by encryption methods, certification of security and other several methods need to be followed.

ii. *Availability:* Cloud service provider promises to make service available to 24X7X365 hours available [2]. Cloud service down affects user's economic and financial status, it is very important for cloud service providers to make cloud service available all time with use of redundant systems and backups and by avoiding net traffic overflow.

iii. *Cost:* There is dependency between availability and cost challenge parameters of cloud computing. High cost is one of the challenges in the cloud computing. The major requirement of cloud computing is that service should be always available (24X7) on the internet. This increases cost of maintenance of hardware and software, electricity requirement and data backup facility [2].

iv. *Performance:* Performance is very important of any computing systems. Cloud computing models also suffers through performance issues [2]. To the cloud service providers it is challenge that to make performance of their system stable throughout the service provided by them. To persist performance of cloud service other alternative methods should be implemented like load balancer, data replicators. high end servers and others [2].

VII. COMPARISON

Distributed Computing

In this environment, complex problems are distributed across independent computers which are geographically not located at same location and these computers provides solution to the part of overall problem. These solutions from all individual computers collected are combined to get final solution for overall complex problem. In this computing

environment, computers with variant architecture, sharing of different data representation formats and system resources is possible [8].

Grid Computing

In this environment, various computers are connected to each other through network to share storage system and to utilize ideal CPU cycles effectively. Grid computing provides service for sharing computers power and data storage over network [8]. In grid computing, multiple processors available on multiple computers works together to enhance the computational power of the applications where high capacity processor is required. Here, multiple servers with shared operating systems and software interact with each other. It provides cheap, reliable, distributable and well organized access to powerful computational capabilities [6]. Grid computing provides sharing of resources. Grid computing shares power, heterogeneous resource which located far away spatially [7].

Distributed computing and grid computing are special types of parallel computing [4] where grid computing is one form of distributed computing [6].

Differences between Cloud Computing and Grid Computing [6][7]:

Table1: Difference between Cloud Computing & Grid Computing

Sr. No.	Property	Cloud Computing	Grid Computing
1	Goal	Provides access to leased computing power and storage capacity from your desktop.	Provides access to shared computing power and storage capacity from your desktop.
2	Resource management	The cloud contains private data centres which are centralized at different locations.	The computing resource centres are distributed over different sites and countries.
3	Services	Cloud is used for long term services	Grid is used to support large set of short term services.
4	Technology	Proprietary technology	Open source technology
5	Functionality	Cloud just take inputs from end users, completes the process that leads to outputs which is invisible.	To perform a single task grid uses the processing capabilities of different computing units.
6	Definition	A Large-scale distributed computing paradigm that is driven by economies of scale, in which a pool of abstracted, virtualized, dynamically scalable, managed computing power, storage, platforms and services are delivered on demand to external customers over the Internet.	A Computational Grid is a collection of heterogeneous computers and resources spread across multiple administrative domains with intend of providing users easy access to these resources.
7	Platform	Cloud computing normally runs in a set of homogeneous computers.	Grid computing runs on heterogeneous computers.
8	Business	Cloud computing is used to provide benefit to small and medium-sized businesses.	Grid computing is used for making big contributions to scientific research, helping scientists around the world to analyze and store massive amounts of data by sharing computing resources.
9	Security	Security is simple and less secure than grid computing.	Grid infrastructure contains different configurations and platforms so security is high.
10	Providers	Clouds are normally provided by vendors, utilized and used as per need of organizations.	Grid is normally on-premise and owned by an organization.
11	Behaviour	It integrates everything into one place.	It divides everything and distributes a task to multiple locations.
12	Services	Cloud provides services like IaaS, PaaS, and SaaS.	Grid provides services like storage, CPU, memory, device etc.
13	Example	Amazon web services, GoogleApps	SETI, CERN

Cloud Computing Advantages [4]:

- Cloud computing user does not need to have high quality and costly equipment.
- Easy to use
- Cloud computing provides reliable and secure data storage centres. Users can not face any data loss or system crash kind of problems.
- Cloud computing provides immediate scale up and scale down facility which helps users in to enhance their business.

VII. CONCLUSIONS

Cloud computing type of computing provides on-demand self service as and when required. It provides services which scalable in up and down manner and pay-per-use mode services. There are different types of cloud available based on access to data is public or private or mix. These types are public cloud, private and hybrid cloud. Service provided under cloud computing is infrastructure or platform or software or database based on which deployment type of cloud computing is defined. In this paper, we compared two computing environments cloud and grid computing. From the comparison it is clear that cloud and grid both have same goal, to provide computing environment for complicated processes. Cloud computing offers more services than grid computing to end users.

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