

## **Grid Computing Vs. Cloud Computing**

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### **Abstract**

Cloud Computing has become another buzzword nowadays. However, there are dozens of different definitions for Cloud Computing and there seems to be no consensus on what a Cloud is. On the other hand, Cloud Computing is not a completely new concept; it has intricate connection to the relatively new but the established Grid Computing paradigm, and other relevant technologies such as utility computing, cluster computing, and distributed systems in general. The service oriented, loose coupling, strong fault tolerant, business model and ease use are main characteristics of cloud computing. Grid computing in the simplest case refers to cooperation of multiple processors on multiple machines and its objective is to boost the computational power in the fields which require high capacity of the CPU. In grid computing multiple servers which use common operating systems and software have interactions with each other. Grid computing is hardware and software infrastructure which offer a cheap, distributable, coordinated and reliable access to powerful computational capabilities. This paper strives to compare and contrast Cloud Computing with Grid Computing from various angles and give insights into the essential characteristics of both.

**Keywords:** cloud computing; grid computing; comparison.

### **1. Introduction**

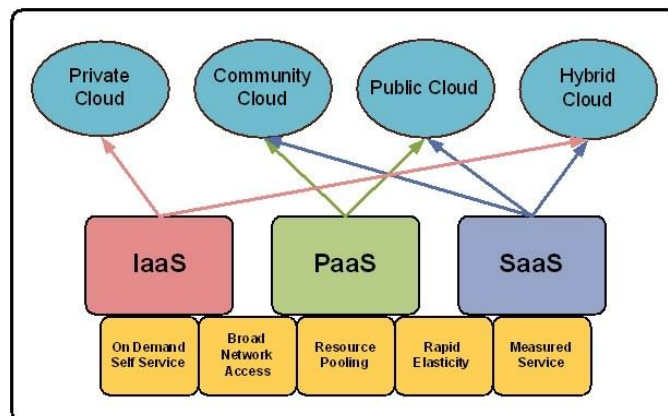
Cloud computing is TCP/IP based high development and integrations of computer technologies such as fast micro processor, huge memory, high-speed network and reliable system architecture. Without the standard inter-connect protocols and mature of assembling data center technologies, cloud computing would not become reality too. The services of cloud computing are broadly divided into three categories:

Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS) [1, 2]. Cloud computing also is divided into five layers including clients, applications, platform, infrastructure and servers. The five layers look like more reasonable and clearer than the three categories [3]. Mixed machine heterogeneous computing (HC) environments utilize a distributed suite of different machines, interconnected with computer network, to perform different computationally intensive applications that have diverse requirements [4]. Miscellaneous resources should be orchestrated to perform a number of tasks in parallel or to solve complex tasks atomized to variety of independent subtasks [5]. Grid computing is a promising technology for future computing platforms and is expected to provide easier access to remote computational resources that are usually locally limited.

According to Foster in [6], grid computing is hardware and software infrastructure which offer a cheap, distributable, coordinated and reliable access to powerful computational capabilities. The purpose of this paper is to characterize and present a side by side comparison of grid and cloud computing and present what open areas of research exist.

## 2. Cloud Computing

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. 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. Those models and their relationship to essential characteristics of cloud computing are shown in Figure 1 [7].



**Figure 1:** The NIST cloud computing definitions.

## 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 [7]:

- Public cloud: The public cloud infrastructure is available for public use alternatively for a large industry group and is owned by an organization selling cloud services.
- Private cloud: The private cloud infrastructure is operated for the exclusive use of an organization. The cloud may be managed by that organization or a third party.
- Hybrid cloud: A hybrid cloud combines multiple clouds (private, community of public) where those
- clouds retain their unique identities, but are bound together as a unit. A hybrid cloud may offer standardized or proprietary access to data and applications, as well as application portability.
- 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.

## 2.2 Service Models

Infrastructure-as-a-Service is the delivery of huge computing resources such as the capacity of processing, storage and network. Sometimes the IaaS is also called Hardware-as-a-Service (HaaS) 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. Software-as-a-Service aims at replacing the applications running on PC. There is no need to install and run the special software on your computer if you use the SaaS.

## 3. Grid Computing

Grid computing is a form of distributed computing that involves coordinating and sharing computing, application, data and storage or network resources across dynamic and geographically dispersed organization. Grid technologies promise to change the way organizations tackle complex computational problems.

The vision of grid computing was to allow access to computer based resources (from CPU cycles to data servers) in the same manner as real world utilities. This gave rise to the idea of Virtual Organizations (VOs). Through the creation of VOs, it was possible to access all resources as though all resources were owned by a single organization. Two key outcomes exist in grids: the Open Grid Service Architecture (OGSA) and the Globus Toolkit .

### 3.1 Grid Characteristics

These characteristics may be described as follows:

*Large scale:* a grid must be able to deal with a number of resources ranging from just a few to millions. This raises the very serious problem of avoiding potential performance degradation as the grid size increases.

*Geographical distribution:* grid's resources may be located at distant places.

*Heterogeneity:* a grid hosts both software and hardware resources that can be very varied ranging from data, files, software components or programs to sensors, scientific instruments, display devices, personal digital organizers, computers, super-computers and networks.

*Resource sharing:* resources in a grid belong to many different organizations that allow other organizations (i.e. users) to access them. Nonlocal resources can thus be used by applications, promoting efficiency and reducing costs.

*Multiple administrations:* each organization may establish different security and administrative policies under which their owned resources can be accessed and used. As a result, the already challenging network security problem is complicated even more with the need of taking into account all different policies.

*Transparent access:* a grid should be seen as a single virtual computer.

*Dependable access:* a grid must assure the delivery of services under established Quality of Service (QoS) requirements. The need for dependable service is fundamental since users require assurances that they will receive predictable, sustained and often high levels of performance.

*Consistent access:* a grid must be built with standard services, protocols and interfaces thus hiding the heterogeneity of the resources while allowing its scalability. Without such standards, application development and pervasive use would not be possible.

*Pervasive access:* the grid must grant access to available resources by adapting to a dynamic environment in which resource failure is commonplace. This does not imply that resources are everywhere or universally available but that the grid must tailor its behavior as to extract the maximum performance from the available resources.

## 4. Comparison

This section puts light to differentiate in different perspectives and give an end-to-end comparison. It could be understood easily when represented in a tabular form as given in table 1.

**Table 1:** GC Vs. CC.

Parameter	Grid computing	Cloud computing
Goal (eliminates the detail)	Collaborative sharing of resources	Use of service

Workflow management	In one physical node	In EC2 instance Amazon (EC2+S3)
Level of abstraction	Low	High
Degree of scalability	Normal	High
Multitask	Yes	Yes
Transparency	Low	High
Time to run	Not real-time	Real-time services
Requests type	Few but large allocation	Lots of small allocation
Allocation unit	Job or task (small)	All shapes and sizes (wide & narrow)
Virtualization	Not a commodity	Vital
Portal accessible	Via a DNS system	Only using IP (no DNS registered)
Operating System	Any standard OS	A hypervisor (VM) on which multiple OSs run
Ownership	Multiple	Single
Discovery	Centralized indexing and decentralized info services	Membership services
Service negotiation	SLA based	SLA based
User management	Decentralized and also Virtual Organization (VO)-based	Centralized or can be delegated to third party
Type of service	CPU, network, memory, bandwidth, device, storage,...	IaaS, PaaS, SaaS, Everything as a service
Future	Cloud computing	Next generation of internet

The cloud is the same basic idea as the grid, but scaled down in some ways, scaled up in others, and thoroughly democratized. Like the grid, the cloud is a utility computing model that involves a dynamically growing and shrinking collection of heterogeneous, loosely coupled nodes, all of which are aggregated together and present themselves to a client as a single pool of compute and/or storage resources.

## 5. Conclusion

In this paper, a detailed comparison on the two computing models, grid and cloud computing has been presented. When it comes to grid and cloud computing, the two are often seen as the same computing paradigm under different names. In this paper, we sought to separate grids from clouds and provide a side by side comparison in how they are assembled and what services are offered. In a word, the concept of cloud computing is becoming more and more popular. Now cloud computing is in the beginning stage. All kinds of companies are providing all kinds of cloud computing service, from software application to net storage and mail filter. We believe cloud computing will become main technology in our information life. Cloud has owned all

the conditions. Now the dream of grid computing will be realized by cloud computing. It will be a great event in the IT history. Grid and cloud computing appears to be a promising model especially focusing on standardizing APIs, security, interoperability, new business models, and dynamic pricing systems for complex services. Hence there is a scope for further research in these areas.

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