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Cloud Computing Vs. Grid Computing

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ABSTRACT

The term "cloud computing" has recently become one of the most talked-about concepts in the IT industry. Several different subfields of computer science serve as inspiration for cloud computing. These include high-performance computing, virtualization, utility computing, and grid computing. In order to clarify the fundamentals of cloud computing, we suggest the features that set cloud computing apart from other study areas and give it its own identity. Cloud computing is characterized by its service orientation, loose coupling, strong fault tolerance, business model, and simplicity of usage. In its most basic form, grid computing involves the coordination of several processors located on separate computers in order to increase processing power in areas that demand it. Grid computing involves collaboration across several computers running the same operating system and software. Grid computing is the use of a network of computers to facilitate the sharing of resources and the distribution of computational tasks in an efficient and cost-effective manner. The purpose of this study is to examine the similarities and differences between cloud and grid computing and to shed light on their key features.

Keywords: cloud computing; grid computing; comparison

INTRODUCTION

The term "cloud computing" refers to a set of technologies that rely on TCP/IP and have seen rapid advancement and integration in recent years. Cloud computing would not be a possibility without sophisticated data center assembly technology and standardized inter-connect protocols. Cloud computing partnership between IBM and Google was first revealed in October 2007 [1]. From that point on, the phrase "cloud computing" began to gain traction. Along with web-based email, services like Amazon Elastic Compute Cloud (EC2) [2], Google App Engine [3], and Sales force's CRM [4] provide a solid theoretical basis for cloud computing. Cloud computing services may be broken down into three main groups: infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS) [5, 6]. Clients, applications, platform, infrastructure, and servers make up the first five levels of cloud computing. Compared to the three groups, the five levels appear more rational and obvious [7]. More than twenty definitions of "cloud computing" exist, each of which appears to ignore or downplay key features of the technology [8]. Computing-intensive tasks with varying specifications can be handled by a distributed cluster of heterogeneous computers in a mixed-machine heterogeneous computing (HC) environment [9]. It's important to coordinate a wide range of resources so that several jobs may be completed simultaneously or so that big problems can be broken down into a set of smaller, more manageable ones [10]. It is anticipated that grid computing would make it simpler to utilize otherwise difficult-to-access remote computational resources, making it a potential technology for future computing platforms. Foster [11] defines grid computing as "a hardware and software infrastructure that provides low-cost, dispersible, coordinated, and reliable access to highly capable computational resources." The goal of this study is to define and contrast grid and cloud computing, outlining research questions that remain unanswered. We explain what cloud computing is and how it differs from grid computing.

CLOUD COMPUTING

The cloud is a topic of conversation at almost every IT firm today. Cloud computing may be understood in a variety of ways [5], despite the lack of a single, definitive definition. The term "cloud computing" refers to a service delivery model in which users have near-constant, anywhere-access to a shared pool of configurable computing resources (such as networks, servers, storage, applications, and services) that can be quickly provisioned and released with little to no management effort or interaction from the service provider. One of the largest consumers of cloud computing networks is the United States government, a massive end user of computer services. Using a set of working definitions, the United States National Institute of Standards and Technology (NIST) divides cloud computing into service models and deployment models. Figure 1 [12] depicts these models and how they relate to key elements of cloud computing.

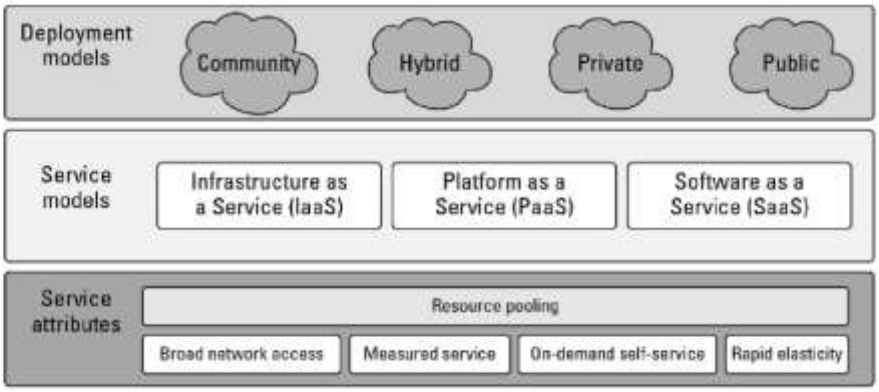

Figure 1: The NIST cloud computing definitions

Models for Deployment

The cloud's function and physical characteristics are specified by its deployment model. Following is NIST's [12] definition of the four deployment models:

• **Public cloud**: The public cloud is owned and operated by a company that provides cloud services to the general public as an option for a sizable sector of the economy.

When it comes to cloud computing, there are two main types: public and private. Either the company itself or an outside entity might be in charge of the cloud.

• **Hybrid cloud**: A hybrid cloud is made up of several clouds working together while yet maintaining their individual identities (public, communal, or private). Data and apps in a hybrid cloud may adhere to industry standards or be kept private, and users may be able to take their work with them if they so want.

The term "community cloud" refers to a cloud that has been set up to benefit a specific group of people. Whether it's for a single company or multiple, the goals, rules, security measures, and compliance requirements are likely to be similar. A community cloud can be overseen either by the participating groups themselves or by an outside entity.

Models of Service

Large-scale computer resources, including those for processing, storage, and networking, are made available via Infrastructure as a Service. Using cloud computing for storage means just paying for the space you really need, without having to worry about where your data is physically stored. Hardware-as-a-Service (HaaS) is another name for IaaS [5, 13].

Platform-as-a-service, or PaaS, is a model for delivering cloud computing infrastructure together with a set of APIs for developing and deploying software. It connects the hardware with the software. Due to the significance of the platform, several large corporations are racing to beat Microsoft to the cloud computing platform. Google's App Engine [3] and Microsoft's Azure Services Platform [14] are two well-known examples.

The goal of SaaS is to make desktop software obsolete. Using SaaS, you may avoid the hassle of downloading, installing, and running specialized software on your PC. Following the pay-as-you-go model instead of purchasing the program outright can help you save money. While certain apps function satisfactorily in the cloud, including several 3D games, the network latency makes using SaaS impractical.

Computing on a Grid

Computing, application, data, storage, and network resources are coordinated and shared across a dynamic and geographically dispersed organization in grid computing [15]. Grid technologies have the potential to revolutionize how businesses approach challenging computational challenges. Grid computing was designed to make computer-based resources (such as processing time and data storage) as easily accessible as traditional infrastructure [16, 17, 18]. Because of this, the concept of a "virtual organization" (VO) emerged. By establishing VOs, it became feasible to use any available resource as though it belonged to a single enterprise. The Open Grid Service Architecture (OGSA) [19] and the Globus Toolkit [20] are two major achievements in the field of grids.

Profiling the Grid

The following descriptors apply to these features:

Scalability means that a grid can handle anything from a few to millions of resources. The issue of preventing performance drops as the grid grows in size is therefore raised.

Distributed resources: the grid's components may be situated in different areas.

Data, files, software components, and programs are all examples of software resources; sensors, scientific instruments, display devices, personal digital organizers, computers, super-computers, and networks are all examples of hardware resources hosted by a grid.

Sharing of resources: in a grid, many distinct organizations' resources are made available to each other's users. As a result, applications may take use of nonlocal resources, which boosts efficiency and cuts costs [21].

Resources controlled by various organizations may be accessible in accordance with their own security and administrative regulations. Thus, it becomes increasingly difficult to provide network security due to the necessity to account for a wide variety of regulations.

Coordination of resources is essential for a grid to deliver on its promise of consolidated processing power.

A grid should be treated as if it were a single virtual computer, with transparent access [22].

Accessibility: a grid must guarantee service delivery in accordance with predetermined Quality of Service (QoS) standards. Users need guarantees that they will obtain consistent, high-quality performance [23, 24], hence dependable service is crucial.

A grid's scalability and reliability depend on its capacity to provide consistent access through the use of standard services, protocols, and inter-faces. Such standards are necessary for the creation and widespread adoption of applications.

Access everywhere: the grid has to work in a dynamic setting where resource failure is prevalent, and yet provide service to users. This doesn't mean resources are always or even widely available; rather, it means the grid needs to adjust its actions so as to get the most out of the components at its disposal [16].

COMPARISON

From a high level of abstraction, grid and cloud computing appear to have many characteristics. In this part, we'll compare and contrast both the beginning and the finish of the process. Table 1 provides a tabular representation that facilitates comprehension.

Parameter	Grid computing	Cloud computing
Goal	Collaborative sharing of resources	Use of service (eliminates the detail)
Computational focuses	Computationally intensive operations	Standard and high-level instances
Workflow management	In one physical node	In EC2 instance (Amazon EC2+S3)
Level of abstraction	Low (more details)	High (eliminate details)
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)
Transmission	Suffered from internet delays	Was significantly fast
Security	Low (grid certificate service)	High (Virtualization)
Infrastructure	Low level command	High level services (SaaS)
Operating System	Any standard OS	A hypervisor (VM) on which multiple OSs run
Ownership	Multiple	Single
Interconnection network	Mostly internet with latency and low bandwidth	Dedicated, high-end with low latency and high bandwidth
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
Resource management	Distributed	Centralized/Distributed
Allocation/Scheduling	Decentralized	Both centralized/decentralized
Interoperability	Open grid forum standards	Web Services (SOAP and REST)
Failure management	Limited (often failed tasks/applications are restarted)	Strong (VMs can be easily migrated from one node to other)

Pricing of services	Dominated by public good or privately assigned	Utility pricing, discounted for larger customers
User friendly	Low	High
Type of service	CPU, network, memory, bandwidth, device, storage,…	IaaS, PaaS, SaaS, Everything as a service
Data intensive storage	Suited for that	Not suited for that
Example of real world	SETI, BOINC, Folding@home, GIMPS	Amazon Web Service (AWS), Google apps
Response Time	Can't be serviced at a time and need to be scheduled	Real-time
Critical object	Computer resource	Service
Number of users	Few	More
Resource	Limited (because hardware are limited)	Unlimited
Configuration	Difficult as users haven't administrator privilege	Very easy to configure
Future	Cloud computing	Next generation of internet

The number of times terms related to a technology are searched for on major search engines may be used as a proxy for the level of interest in that technology. Google Trends is exactly what you're looking for in a service like this. This tool allows us to examine the relative popularity of various search phrases over time. Figure 2 displays Google Trends data. Both "Grid Computing" (in red) and "Cloud Computing" (in blue) are shown. To see how "Cloud Computing" stacks up against "Dedicated Server" and "Virtualization," see Figure 3. As you can see, "Cloud Computing" is shown in blue, "Grid Computing" in red, "Dedicated Server" in orange, and "Virtualization" in green.

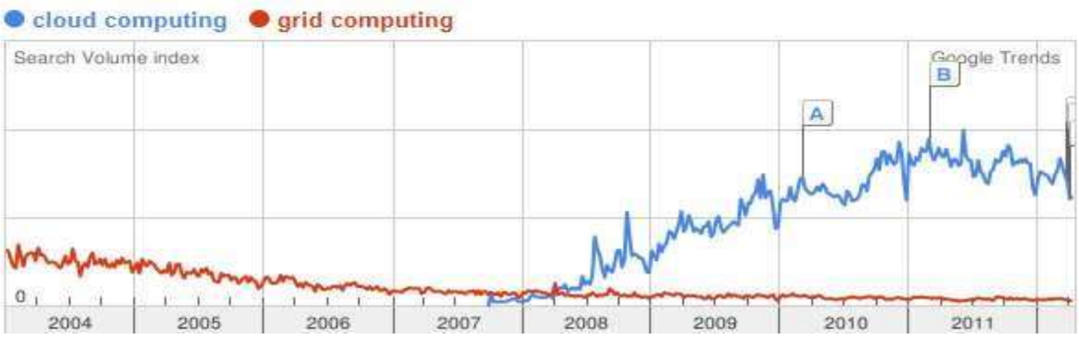

Figure 2: Google trends of Grid computing and Cloud computing

Figure 3: Google trends of new concepts

The cloud is a utility computing architecture with similarities to the grid in that it allows for the dynamic scaling down and scaling up of a diverse and highly decentralized set of computing resources. Similar to a grid, the cloud consists of a collection of unconnected computers or servers that are pooled together and presented to users as a single large system. Although the cloud and grid models appear identical from the server side, there are significant client-side distinctions. The cloud provides its services to hundreds or even millions of users, rather than just a handful, and often serves many users per node. Clients like this typically have short-lived jobs (such database queries or HTTP requests), which may need a lot of storage or bandwidth but are computationally light. To see how Clouds connects to the other fields it touches (and how), check out the diagram in Figure 5. When it comes to service-oriented applications, Web 2.0 pretty well covers it all, but Cloud Computing is where things become really big. Although it shares some ground with these other areas, Grid Computing is typically seen as being on a smaller scale than both supercomputers and Clouds. Here, we take a quick look at several popular grid computing and cloud computing apps and technologies (see tables 2 and 3).

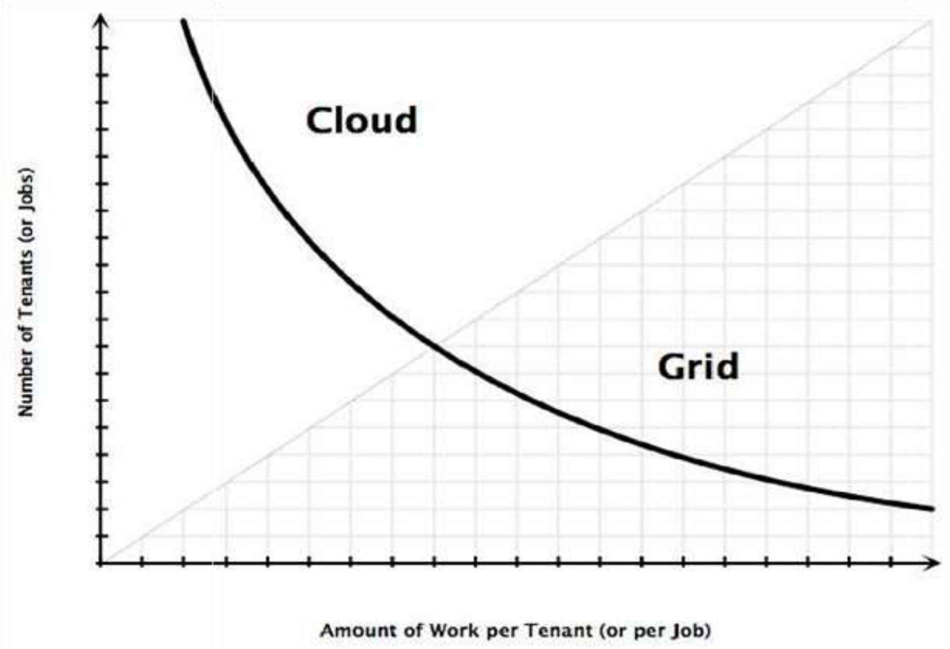

Figure 4: Scale comparison

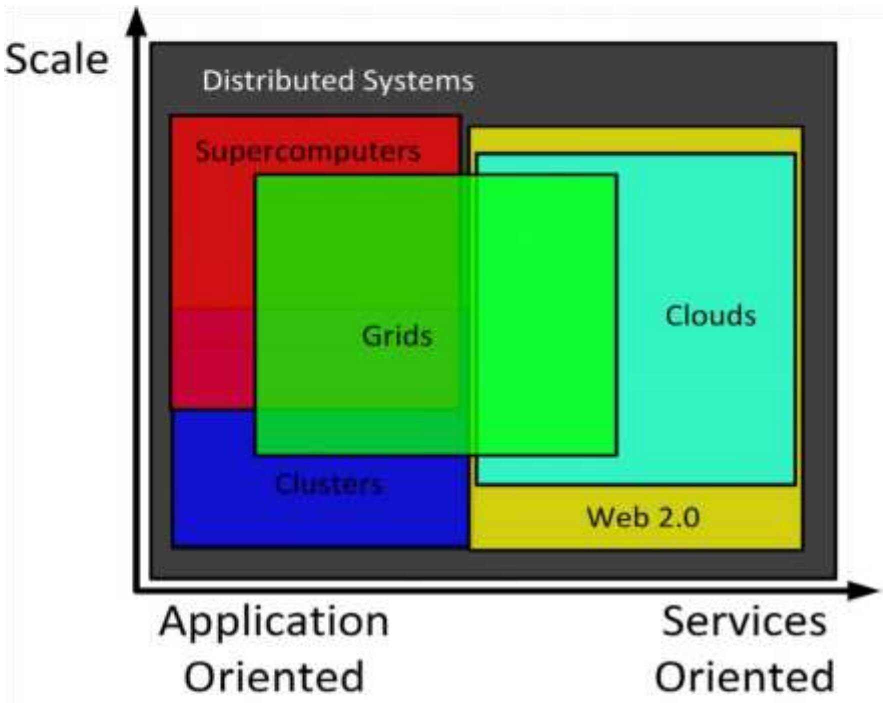

Figure 5: Grids and Clouds Overview [25]

Table 2: Grid and Cloud applications

Technology	Application	Comment
Grid	DDGrid (Drug Discovery Grid)	This project aims to build a collaboration platform for drug discovery using the state-of-the-art P2P and grid computing technology [27].
	MammoGrid	It is a service-oriented architecture based medical grid application [26].
	Geodise	Geodise aims to provide a Grid-based generic integration framework for computation and data intensive multidisciplinary design optimization tasks.
Cloud	Cloudo	A free computer that lives on the Internet, right in the web browser.
	RoboEarth	Is a European project led by the Eindhoven University of Technology, Netherlands, to develop a WWW for robots, a giant database where robots can share information about objects [28].
	Panda Cloud antivirus	The first free antivirus from the cloud [29].

Table 3: Grid and Cloud tools

Technology	Tool	Comment
Grid	Nimrod-G	Uses the Globus middleware services for dynamic resource discovery and dispatching jobs over computational grids [30].
	Gridbus	(GRID computing and BUSiness) toolkit project is associated with the design and development of cluster and grid middleware technologies for service oriented computing [31].
	Legion	Is an object-based meta-system that supports transparent core scheduling, data management, fault tolerance, site autonomy, and a middleware with a wide range of security options [32].
Cloud	Cloudera	An open-source Hadoop software framework is increasingly used in cloud computing deployments due to its flexibility with cluster-based, data intensive queries and other tasks [33].
	CloudSim	Important for developers to evaluate the requirements of largescale cloud applications.
	Zenoss	A single, integrated product that monitors the entire IT infrastructure, wherever it is deployed (physical, virtual, or in cloud).

CONCLUSION

In this study, we contrast and compare grid and cloud computing in great depth. We think that by drawing parallels between the two, we can speed up the transition from early prototypes to production systems in Cloud Computing by increasing mutual understanding, sharing, and evolution of infrastructure and technology within and between the two groups. Many people mistake grid and cloud computing for one another because of their similarities. In this work, we set out to differentiate grids from clouds and present a side-by-side analysis of their construction and the services they provide. In a nutshell, the idea of cloud computing is gaining traction. The era of cloud computing has just begun. Various businesses now provide various cloud computing services, such as software, data storage, and email filtering. We anticipate cloud computing to emerge as a fundamental component of our digital infrastructure. Cloud has complete control on the weather. Cloud computing is finally making grid computing a reality. For the industry of information technology, this is a momentous occasion. Standardizing APIs, security, interoperability, new business models, and dynamic pricing systems for complex services all seem to be areas where grid and cloud computing may make a significant impact. Therefore, there is need for more study in these fields.

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