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Assessment of Grid and Cloud Computing

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Abstract— Cloud computing is based on several other computing research areas such as HPC, virtualization, utility computing and grid computing. 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

I. 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), Platformas- a-Service (PaaS), and Software-as-a- Service (SaaS). 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. 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. Miscellaneous resources should be orchestrated to perform a number of tasks in parallel or to solve complex tasks atomized to variety of independent subtasks. 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, 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.

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II. 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

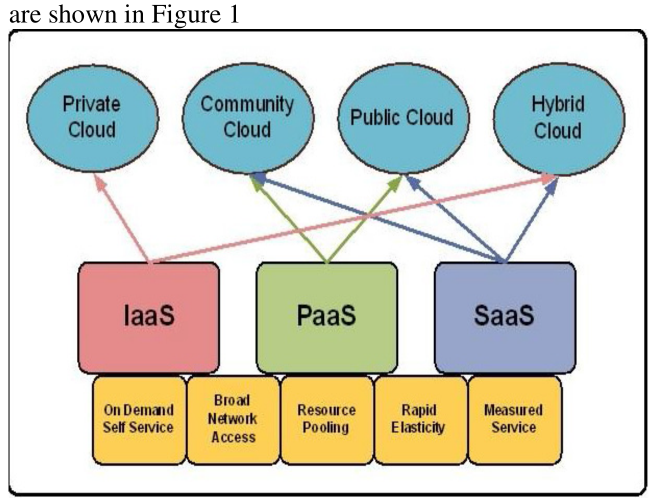


Figure 1: The NIST cloud computing definitions.

A. *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

• **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.

B. *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.

III. 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 Tool kit.

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.
- **Resource coordination:** resources in a grid must be coordinated in order to provide aggregated computing capabilities.
- **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 inter-faces 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 behaviour as to extract the maximum performance from the available resources.

IV. COMPARISON

Viewed in a broad sense, the concepts of grid and cloud computing seems to have similar features. 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.

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)
Interconnection network	Mostly internet with latency and low bandwidth	Dedicated, high-end with low latency and high bandwidth
Infrastructure	Low level command	High level services (SaaS)
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
Failure management	Limited (often failed tasks/applications are restarted)	Strong (VMs can be easily migrated from one node to other)
Number of users	Few	More

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. And scale comparison of grid and cloud computing representation by figure 2.

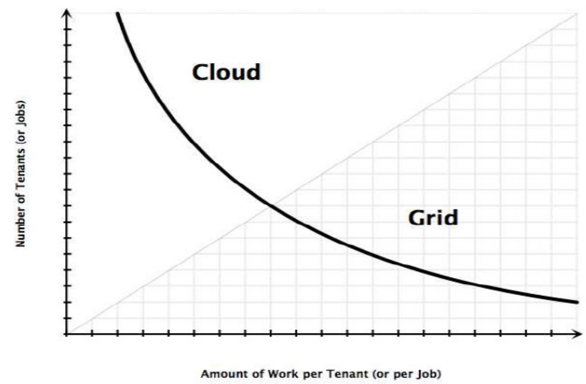


Figure 2: Scale comparison

One indicator of the buzz or hype of a particular technology can be examined by the search volume of keywords in popular search engines. Google has just this type of tool with their Google Trends. With this tool, we can compare different search terms against each other and view how the search volume changes over time. The Google trends showed in Figure 3. In red is "Grid Computing" and in blue is "Cloud Computing".

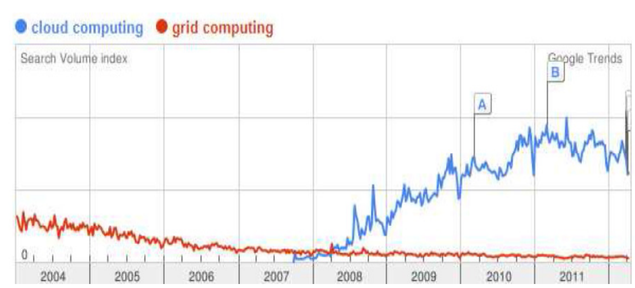
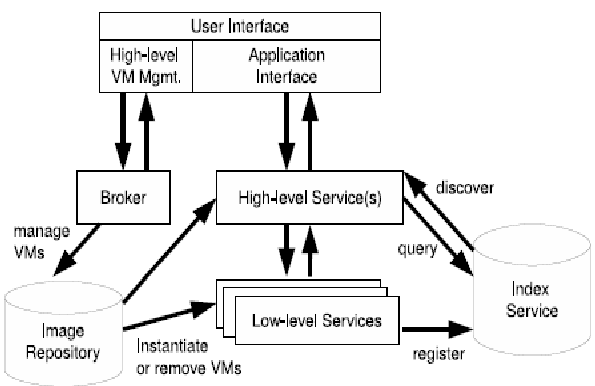


Figure 3: Google trends of Grid computing and cloud computing.

V. CONVERGENCE OF GRIDS AND CLOUDS

Various approaches exist, combining Clouds and Grids together can be seen as a combination of advanced networking with sophisticated virtualization. However, Grids need to accelerate the incorporation of virtualization technologies to be nearby Clouds, by gaining some advantages that Clouds show (migrability, hardware level scalability).entry points so as to enable a wider adoption by end users, i.e., Grids are meant to be virtualized and automatically scalable utilities, which clearly shows a convergence with current Clouds . The problem of delivering the user's needs leads to reducing and escalating in service's computing resource. Therefore, implementing the cloud on third-party infrastructure can optimize the payment cost. In addition, to widen the spectrum of offers and stimulate competition the same Grid services can be deployed with different computing problems .There are two solutions to deal with increased processing power, additional low-level services can be deployed automatically, and to deal with increased number of users, additional high-level services can be instantiated to serve the interface . Firstly, solution is based on incorporating an index service to register grid services. Secondly, load balancing can be used to achieve this approach at interface nodes. For example, a master-worker is implemented as multiple workers who need only to register themselves with the index service to become available to the master. The figure below shows a scenario compatible with the master-worker Paradigm.



VI. SECURITY AND POLICY ISSUES IN CLOUD AND GRID COMPUTING

Cloud and grid computing technologies are used as inexpensive systems to gather and utilize Computational capability together. The homogeneity within each data centre in the infrastructure is the main feature for the cloud computing compared to grid computing. In this case, any conflict between a heterogeneous data centre and different administration domains can become a serious issue for cloud interoperability. It can be seen that the stages of anonymity and privacy provided by cloud to the external users will be less than the user of desktop in numerous situations. On the other side, grids was originally established on the idea that resources infrastructure are dynamic and heterogeneous in their nature. This means different organization with different administrative domains. This also means that security was taken into account from the beginning when the grid system was originally built. Presently, the security paradigm for clouds appears to be fairly less secure than the model in grids environment. The infrastructure of the cloud normally depends on web models (over SSL) to establish and access account information for the external users, and allows them to change or reset their keys (passwords) with a new ones by email in what can be considered as unencrypted communication. In general, the data in the cloud environment is distributed over multiple servers in the cluster and hosted by third parties (at least for some time) who are hidden from the data owner or the external users. This means the privacy of the users' data and ability to give the permissions to handle this data to a specific domains or users by the original data owner is less than expected.

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.
	Mammo Grid	It is a service-oriented architecture based medical grid application.
	Geodise	Geodise aims to provide a Grid-based generic integration framework for computation and data intensive multidisciplinary design optimization tasks.
Cloud	Cloud	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.
	Panda Cloud antivirus	The first free antivirus from the cloud.

Table 3: Grid and Cloud tools

Technology	Tool	Comment
	Nimrod-	Uses the Globus middleware services for dynamic

Grid	G	resource discovery and dispatching jobs over computational grids.
	Gridbus	(GRID computing and Business) toolkit project is associated with the design and development of cluster and grid middleware technologies for service oriented computing.
	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.
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.
	CloudSim	Important for developers to evaluate the requirements of large scale cloud applications.
	Zenoss	A single, integrated product that monitors the entire IT infrastructure, wherever it is deployed (physical, virtual, or in cloud).

VII. CONCLUSION

Using cloud computing might contribute to improvement of services in other related technologies specially the previous generations such as Grid computing. Cloud computing is almost certainly set to be developed and become an attractive option for many corporations. The future of computing is set to be successful. It is the next generation and can provide tremendous value to companies. It can help companies achieve more efficient use of their IT hardware and software investments, which in turn can lead the acceleration and adoption of innovations. Clouds consist of data centres which are owned by the same institute. The homogeneity within each data centre in the infrastructure is the main feature for the cloud computing compared to grid computing. In this case, any conflict between a heterogeneous data centre and different administration domains can become a serious issue for cloud interoperability. It can be seen that the stages of anonymity and privacy provided by cloud to the external users will be less than the user of desktop in numerous situations. on the other side, grids were originally established with the knowledge that resources infrastructure are dynamic and heterogeneous in their nature. This implies different organization with different administrative domains. This also means that security was taken into account from the beginning when the grid system was originally built. Presently, the security paradigm for clouds appears to be less secure than the model in grids environment. It has been arguably said that the cloud computing might reduce the cost of the infrastructure by shrinking the number of resources such as servers.

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