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A Review on Grid and Cloud Computing On Performance Basis

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Abstract: ***Cloud computing is pay- as- you- use model which is based on the principle that the end user pays only for the services (such as computer platform, infrastructure and data storage) that are used or reserved by the user. In computing era, it is considered as a great revolution that developed after grid computing. Grid computing refers to collection of computer resources applying to compute single problem from different locations at same time. The integral part in computing environment is performance monitoring. This paper makes an attempt to compare the performance of grid and cloud computing and suggesting newer methods to enhance the performance for fast retrieval of data.***

Keywords: Cloud Computing, Grid Computing, Performance, Quality of Service

1. Introduction

The services of cloud computing are made available to the users as soon as they make a request (on-demand). This is a cost-effective way to access computer resources irrespective of the location. However, cloud computing is not entirely a new concept and is driven from grid computing paradigm and other technologies such as utility computing, autonomic computing, cluster computing and distributed in general. In early 1990's, the term grid computing originated to make computer power as easily accessible as electric power grid. This allowed users to obtain computational power on demand. However, things are different due to increase in demand of computing. Therefore, for massive data analysis there's a need to employ various tools and techniques for enhancing the performance of these technologies for faster retrieval.

2. Cloud Computing

Cloud computing is pay- as- you- use model i.e., users are paying only for resources being reserved or utilized. These resources can be infrastructure, platform or software application that is delivered over a network as a service. Government, researchers and business tycoons and so on are now referring cloud computing to increase their ever-growing computing and storage problems. Some leading platforms that are in use today are Amazon Web Service (AWS), Google App Engine (GAE), HP Cloud Enabling Computing, Microsoft, IBM Cloud Computing and Salesforce.com. Some common characteristics that cloud computing shares are as follows:

1. *Autonomic Computing*: It is capable of self management.
2. *Utility Computing*: Package of computer resources as a metered service just similar to traditional public utility.
3. *Client-Server Model:* It is distributed application distinguishes between service provider and service requester.
4. *Mainframe Computing:* It is bulk data processing e.g., Transaction Processing, Enterprise Resource Planning (ERP), Census and so on.
5. *Peer- to- Peer Computing*: It is, without using centralized administrative systems, nodes are sharing computer resources amongst each other.
6. *Grid Computing*: In this, collection of computer resources is made available from different location to compute single problem at a same time and making it easily accessible as electric power grid.

2.1 Broader view of cloud

The broader view of cloud is shown below:

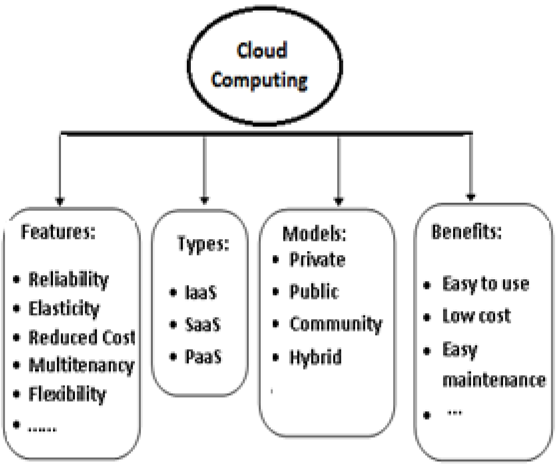

Figure 1: Broader view of cloud

Thus, in the broadest terms, a 'cloud' is an elastic execution environment of resources involving multiple stakeholders and providing a metered service at multiple granularities for a specified level of quality of service (QoS). [2]
Various Stakeholders are providers, resellers, adopters and users.

2.2 Service Models

Generally cloud providers offer their services as per three fundamental models discussed below:

1) *IaaS (Infrastructure as a Service):*
In such service model, cloud providers offer user computer as physical or virtual machine and other resources. Typically, providers bills on utility computing

basis i.e., amount of resources are allocated and consumed.
Examples: Amazon CloudFormation, Terremark, Rackspace Cloud and Google Compute Engine.

2) *PaaS (Platform as a Service):*
In such service model, cloud providers offer user systems as platform such as operating system(OS), database, programming language execution environment and web servers. It is helpful for application developers to develop and run on cloud platform without installing the actual required software.
Examples: Amazon Elastic Beanstalk, Heroku, EngineYard, Google App Engine and Microsoft Azure.

3) *SaaS (Software as a Service):*
In such service model, cloud providers installs and operates application software in cloud and cloud clients allow its access to the cloud users. Hence it eliminates the need to install and run application on user's own computer. Typically, providers bills SaaS services falt on month or year basis per user.
Examples: Google Apps, Quickbooks, Salesforce.com and Microsoft Office 365.

2.3 Cloud Deployment Models

There are four types of deployment models described below:

1) *Public Cloud:* In such types, applications and other resources are made available to general public by the service provider which are generally free or pay-per- use model.
Examples: Amazon AWS, Microsoft and Google.
2) *Private Cloud:* In such types, cloud infrastructure are operated solely for single organization that are managed and hosted internally or externally.
Examples: e-bay
3) *Community Cloud:* In such types, from specific community, cloud infrastructure is shared between several organizations that are managed and hosted internally or externally.
4) *Hybrid Cloud:* In such types, cloud is composite of two or more clouds that are bound together but remains a unique entities. It is when some resources are provided and managed in-house or provided externally such as Amazon's Elastic Compute Cloud (EC2).

2.4 Cloud Characteristics

Following are the various characteristics of cloud computing:

- It is on-demand service.
- It provides Application Programming Interface (API).
- It is easy to maintain and manage.
- It reduces costs and capital expenditure to a large extent.
- It provides rapid elasticity.
- It is flexible and scalable as it delivers resources dynamically to users.

2.5 Risks

Several risks are involved while using cloud computing is as follows:

- Lack of transparency
- Reliability and performance issues
- Security and compliance issues
- Data leakage risk
- Viability of cloud service- provider
- Application portability risk
- Cyber attack targets

3. Grid Computing

In early 1990s, grid computing originated and is referred as a collection of computer resources applying on single problem from multiple locations at a same time. Grid computing is based on many ideas such as utility computing, shared computing and so on. There are four layers in grid architecture: the network, resource layer, middleware layer and application layer. For connecting grid resources we need network layer and this layer is the lowest layer in grid architecture. Resource layer lies just above the network layer where all grid resources are present such as storage systems, sensors and so on that connects to network. Above resource layer lies the middleware layer that enables the elements to participate in grid. This middleware layer is recognized as "brain" behind computing grid. After middleware layer the highest layer is application layer which helps users to interact with.

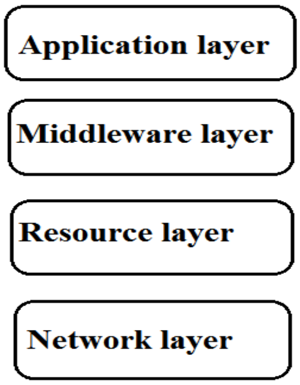

Figure 2: Grid Architecture

Generally grid computing consists of one main computer that is responsible of distributing information and tasks over a group of networked computers to achieve common goal. This is often used to complete complicated or tedious mathematical or scientific calculations.

3.1 Grid Characteristics

The characteristics of grid computing may be described as below:

1) *Resource Sharing* – this allows many different organizations to share their resources amongst other organizations in a grid.
2) *Consistent Access* – while a grid is built some standard services, protocols and interfaces must to be kept in mind to hide heterogeneity of resources and allowing it to be scalable.
3) *Resource Coordination* – in order to provide aggregated computing capabilities, resources in grid must be coordinated properly.

4) *Transparent Access* – it must appear as a single virtual computer to user.
5) *Geographically Distributed* – resources in grid may be located at multiple different locations.
6) *Large Scale* – this deals with number of resources in a grid. As grid size increases, the performance degradation is avoided due to large scale of resources available.
7) *Heterogeneous* – grid deals with both software and hardware resources.
8) *Multiple Administrations* – each and every organization deploy different security and policies on the basis on which their owned resources can be accessed and used.
9) *Dependable Access* – it must assure the delivery of services to the users that they will receive predictable, sustainable and high level of performance.

4. Comparing Grid and Cloud

4.1 Overview: Grid and Cloud

An overview can be shown in following figure giving relationship between the cloud and many other fields and also showing overlapping amongst them. In a figure below, it is clear that distributed systems cover both application and service oriented properties. Whereas Web 2.0 almost covers the spectrum of service oriented applications and cloud computing lies at large scale side. Supercomputers and cluster computing are considered to be application oriented.

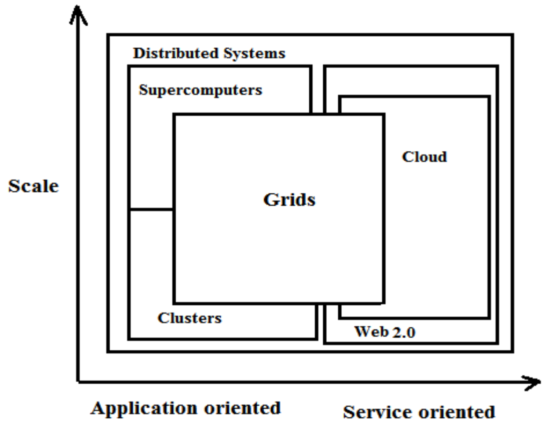

Figure 3: Overview of grid and cloud computing

4.2 Comparison on Performance Basis

On the basis of performance, comparison between grid and cloud computing is as follows:

1. The goal of grid computing is collaborative sharing of resources while cloud computing eliminates the detail by use of services.
2. Grid computing focus on computational intensive operations but cloud computing focuses on standard and high level instance.
3. There is high level of abstraction as compared to grid computing.
4. The degree of scalability is high in cloud computing than grid computing.
5. In cloud computing, there is more transparency than the grid one.
6. Cloud computing is real time but grid computing is not.
7. Transmission in grid computing suffered from internet delays whereas cloud computing was significantly fast.
8. In grid computing any standard operating system can be used. But in cloud computing a hypervisor on which multiple operating systems can run is used.
9. The level of security in grid is low than that of cloud due to virtualization.
10. In grid computing, resources are managed distributed over the network but in cloud resources can be centralized or distributed.
11. There is a limited possibility of failure management in grid and often failed applications are restarted. Whereas in failure management in cloud is strong as virtual machines can easily migrate from one node to another.
12. Cloud computing is more user-friendly than grid computing.
13. Types of services in grid are CPU, memory, network, bandwidth, devices, and storage and so on. Whereas cloud provides infrastructure, platform and software as a service to the users.
14. Resources in grid computing is limited because of limited hardware but not with the case with cloud i.e., unlimited resources available.
15. There are few number of users in grid computing than cloud computing.

4.3 Grid and Cloud Tools

The tools in grid and cloud computing along with some information are as follows in table below:

Table 4: Applications and uses of Grid and Cloud

Technology	*Application*	*Uses*
Grid	Nimrod-G	For dynamic resource discovery and dispatching jobs over computational grids Nimrod-G uses Globus middleware services.
	Gridbus	Gridbus stands for Grid Computing and Business.
	Legion	To support transparent core scheduling, fault tolerance, data management and site autonomy legion is an object based meta-system.
Cloud	Cloudera	It is an open source, Hadoop software framework that is used more often in cloud computing deployments.
	CloudSim	It helps developers to evaluate large scale cloud applications.
	Zenoss	Wherever it is deployed, it monitors the entire IT infrastructure.

4.4 Grid and Cloud Applications

Following table depicts the technology along with applications:

Table 5: Applications of Grid and Cloud

Technology	*Application*
GRID	• Drug Discovery Grid (DDGrid) • MammoGrid • Geodise
CLOUD	• Cloudo • RoboEarth • Panda Cloud Antivirus

5. Performance

The quality of service (QoS) that service provider provides to the customer over the network is defined as performance. Performance can be calculated in different ways as each node possesses different nature, design and topology. Service Level Agreement defines some performance metrics that are used to calculate and compare results of performance amongst different service providers in cloud computing. Generally there are many cloud leading platforms but the two main leading platforms are GAE and AWS. The performance analysis of the two leading platforms with traditional web servers is obtained. The throughput of Google App Engine strongly depends on data size. That is, if data size over a network is reduced then throughput is increased simultaneously.

$$\text{Throughput} \propto \frac{1}{\text{Data Size}}$$

This depicts that throughput is inversely proportional to data size sent over the network.

6. Conclusion

The paper represents a comparison of grid and cloud computing technologies on the basis of performance. In computing era, Cloud Computing is highly gaining popularity due to which the web applications are delivering the computer services over the Internet on-demand. The dream of grid computing is being realized by the cloud computing now. Grid and cloud computing appear to be a promising model especially focusing on standardizing Application Programming Interfaces (API's), security, interoperability, new business models, and dynamic pricing systems for complex services.

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