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A Comparative Study on Grid Computing and Cloud Computing

KEYWORDS: Cloud computing, Grid, Scheduling, Resource Management.

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ABSTRACT *Grid and Cloud computing are new paradigms useful in heavy workload processing. Grid computing works as a grid of computing nodes in a manner like electricity grid. Cloud computing is providing on demand elastic computing resources usually on a pay per basis. There are so many situations where grid computing and/or cloud computing can be used. This paper surveys both grid computing and cloud computing and will be useful for researchers, students, and commercial users.*

INTRODUCTION

Cloud computing: Cloud computing refers to the collection of hardware, software and remote servers working collectively in a network to provide services like resource sharing, storing, managing and processing of data to the end user [1]. The primary advantage of using cloud computing is cost saving. There are many cloud service provider facilitating hardware and software services. Hardware services enable user to have equipments at remote location where as through software services one can make his application run over the entire network or a company may store its data on server at some other location by service provider. A hybrid computing provides public and private cloud to store public data and sensitive data in respective clouds. The common examples of cloud computing are Google drive, online version of word, spread sheet, presentation etc.

Grid Computing: Grid computing implies collection of millions of computers, laptops, super computers, instruments like mobiles owned by different people over the entire world, taken together as a single huge computer in order to reach a complex goal like complicated mathematical or scientific calculations [2]. Grid computing is like distributed computing, but their basic ideas are different as in distributed computing remote and independent computers take part to solve a problem and grid computing aims to utilize idle cpu cycles and storage capacity of all computer over the internet.

Service model of cloud computing as given in [3]: Fundamental Models for providing service in Clouds are:

Infrastructure as a service: This model manages server, storage and virtualization. It helps in managing application, middleware, data etc. Hardware cost saving is the advantage of this model.

Platform as a service: This model provides platform for computing such as operating system, execution environment for an application. This layer enables to run software without paying for the cost of required underlying software and hardware.

Software as a Service In this model user may have an access to application software and databases. The applications are installed and operated on cloud service provider and the user can execute them as cloud client. The user needs not to pay licensing fee for the software. One of the common examples of SaaS is online banking.

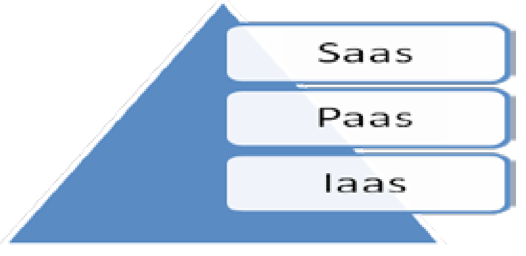
Deployment model for cloud computing as given in [3]: Four deployment models of clouds are

1. Private Cloud: Private cloud works for restricted environment. It limits the access to the resources and requires high security and privacy. Expertise is needed to build and maintain such models .

2. Public cloud: Public cloud is true cloud. This cloud is ideal for managing applications that are consumed by a large group of users. Anyone can sign up to access the services.

3. Hybrid cloud:Hybrid cloud combines features of both private cloud and public cloud with the advantages of security in private cloud and resource and application sharing in public cloud.

4. Community Cloud: This deployment model serves several organizations with common considerations, policies and shared concerns.



Rest of the paper is as follows: section 2 discusses related works of Grid and Cloud computing. In Section 3, conclusion and our contribution is presented.

BACKGROUND

A large body of literature is available on grid computing and cloud computing. Various research groups are exploring the ways to use grid and cloud computing as next generations paradigm shift.

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Literature on Grid computing and scheduling of resources:

Deelman et al. described the Pegasus system that can map complex workflows onto the Grid in [4]. Pegasus takes an abstract description of a workflow and finds the appropriate data and Grid resources to execute the workflow [4].

Buyya et al. developed a Java-based discrete-event Grid simulation toolkit called GridSim. The toolkit supports modeling and simulation of heterogeneous Grid resources (both time- and space-shared), users and application models. GridSim provides primitives for creation of application tasks, mapping of tasks to resources, and their management. To demonstrate suitability of the GridSim toolkit, Buyya et al. simulated a Nimrod-G like Grid resource broker and evaluated the performance of deadline and budget constrained cost- and time-minimization scheduling algorithms [5].

Buyya et al. discussed the use of models for interaction between Grid components to decide resource service value, and the necessary infrastructure to realize each model in [6].

Hamscher et al. discussed typical scheduling structures that occur in computational grids in [7]. Scheduling algorithms and selection strategies applicable to these structures were introduced and classified by the authors. Simulations were also used to evaluate these aspects considering combinations of different Job and Machine Models [7].

Dong et al. reviewed the challenges for Grid scheduling. They described first, the architecture of components involved in scheduling, to provide an intuitive image of the Grid scheduling process. Then various Grid scheduling algorithms were discussed from different points of view, such as static vs. dynamic policies, objective functions, applications models, adaptation, QoS constraints, strategies dealing with dynamic behaviour of resources, and so on by the authors in [8].

Literature on cloud computing and scheduling of resources:

Sotomayor et al. presented a model for predicting various runtime overheads involved in using virtual machines, that allows efficient support advance reservations in [9].

Shrivastava et al. proposed two algorithms 1) Starvation-Removal and 2) AR-to-BE Conversion to solve problems related to resource management. They demonstrated experimentally results of the proposed algorithms to stop starvation of BE leases for resources and effectively improve request acceptance rate [10]. Starvation removal algorithm with improvements was also proposed in [11].

In [12] CBUD Micro, a performance evaluation tool was presented that can be used at both cloud host and consumer side for resource management by supporting scheduling decisions. They also described the vision and architecture of CBUD Micro in detail and and the way in which core components were implemented.

In [13] a new leasing policy named CRI (Consumer Rating Index) and an algorithm for prioritizing consumers on the basis of CRI scores was proposed to manage the cloud host resources properly. This policy and algorithm can be used for efficient functioning at cloud hosts side was also presented.

In [14] mEDF (Modified Earliest Deadline First) algorithm and leasing policy for deadline driven resource management was introduced. This algorithm takes care of minimum capacity expenses at cloud host side. mEDF can be used for deadline driven scheduling with minimizing response time and completion time.

COMMA (Cost Oriented, Market and Migration Aware) for maintaining a balance between cost, profit and migrations of VM during peak loads was introduced in [15]. This paper showed that COMMA leasing policy and algorithm are effective and can be used for making profit and maintain QoS in a cloud environment.

Cloud service negotiation techniques were presented in [16]. Authors also presented a survey of challenges and current state of resource negotiation. They showed the different agent based methods for cloud negotiation. The focus was on most advanced agent cloud coordinator that will be able to deliver Quality of Service (QoS) for cloud provider so that it allows an increase in performance, reliability and scalability of applications.

Foster et al. presented a study in [17] that strives to compare and contrast Cloud Computing with Grid Computing from various angles and give insights into the essential characteristics of both.

Beloglazov et al. conducted a survey of research in energy-efficient computing and propose: (a) architectural principles for energy-efficient management of Clouds; (b) energy-efficient resource allocation policies and scheduling algorithms considering QoS expectations and power usage characteristics of the devices; and (c) a number of open research challenges, addressing which can bring substantial benefits to both resource providers and consumers [18].

Buyya presented vision, challenges, and architectural elements for energy-efficient management of Cloud computing environments. they focused on the development of dynamic resource provisioning and allocation algorithms that consider the synergy between various data center infrastructures (i.e., the hardware, power units, cooling and software), and holistically work to boost data center energy efficiency and performance [19].

Pandey et al. presented a particle swarm optimization (PSO) based heuristic to schedule applications to cloud resources that takes into account both computation cost and data transmission cost. They experimented with a workflow application by varying its computation and communication costs. They compared the cost savings when using PSO and existing 'Best Resource Selection' (BRS) algorithm. Their results show that PSO can achieve: a) as much as 3 times cost savings as compared to BRS, and b) good distribution of workload onto resources [20].

Hoffa explored the use of cloud computing for scientific workflows, focusing on a widely used astronomy application-Montage. The approach was to evaluate from the point of view of a scientific workflow the tradeoffs between running in a local environment, if such is available, and running in a virtual environment via remote, wide-area network resource access [21].

Zhang presented a survey of cloud computing, highlighting its key concepts, architectural principles, state-of-the-art implementation as well as research challenges. The aim of his paper was to provide a better understanding of the

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design challenges of cloud computing and identify important research directions in this increasingly important area [22].

Beloglazov et al. proposed an energy efficient resource management system for virtualized Cloud data centers that reduces operational costs and provides required Quality of Service (QoS). Energy savings were achieved by continuous consolidation of VMs according to current utilization of resources, virtual network topologies established between VMs and thermal state of computing nodes [23].

Comparison between Cloud and Grid Computing

Cloud Computing	Grid Computing
It is based on Client server architecture	It is similar to Distributed computing
Cloud provides software and hardware Service on lease	Provides access to shared computing power
Resources are distributed/centralized	Resources are distributed
No. of users are more	Number of users less.
One task is divided into many small jobs and executed on multiple machines	Several users are served with the services simultaneously

Table 1: Comparison of Cloud and Grid Computing [24]

Conclusion

Cloud computing and grid computing both are useful in their application areas. Scheduling of resources is also a major factor in grid and cloud computing to exploit the full power of both computing paradigms. Various algorithms and policies for the same are discussed in this paper. Algorithms based on discussed problems and their solutions are the foremost research topics and need attention of scientific community.

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