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Cloud Computing Over Cluster, Grid Computing: a Comparative Analysis

[1]Indu Gandotra, [2]Pawanesh Abrol, [3]Pooja Gupta, [3]Rohit Uppal and [3]Sandeep Singh
[1]*Department of MCA, MIET, Jammu*
[2]*Department of Computer Science & IT, Jammu Univ, Jammu*
[3]*Department of MCA, MIET, Jammu*
e-mail: indugandotra83@rediffmail.com, pawanesh_a@yahoo.co.in,
pooja_gupta97@yahoo.com, m_rohit_uppal@yahoo.in, sunny_sun7@yahoo.com

Abstract—There are dozens of definitions for cloud computing and through each definition we can get the different idea about what a cloud computing exacting is? Cloud computing is not a very new concept because it is connected to grid computing paradigm whose concept came into existence thirteen years ago. Cloud computing is not only related to Grid Computing but also to Utility computing as well as Cluster computing. Cloud computing is a computing platform for sharing resources that include software's, business process, infrastructures and applications. Cloud computing also relies on the technology of virtualization. In this paper, we will discuss about Grid computing, Cluster computing and Cloud computing i.e. what they exactly are and how each one is different from the other. In this paper we will also highlight the future of computing as cloud computing.

Keywords: Grid computing, cluster computing, cloud computing, utility computing

I. INTRODUCTION

In olden days there were time shared computing systems. Big and expensive computers were kept behind big glass walls, tended by shrouded acolytes. For rest of life it was like "keep their hands off"[1]. In 1990's the term Grid was coined to describe technologies that would allow consumers to obtain computing power on demand [3]. Then researches developed their ideas to develop large scale federated systems that was used to provide not just computing power but also data and software's on demand [4]. The term was also co-opted by industry as a marketing term for clusters emerged till now. Then the idea of cloud computing came into existence to reduce the cost of computing, to increase reliability and increase flexibility by transforming computers from something that we buy and operate ourselves to something that is operated by the third person[4].

Now, the things are quite different from what they were 10 years ago. Today, there's a great need of computing than it was in the age of main frames. Now we are moving from mainframes to commodity clusters but clusters are quite expensive to operate.

Cloud computing is hinting at a future in which we will not compute on local computers but on the centralized facilities operated by the third party and storage utilities [4]. It also relies upon virtualization. Virtualization is a technology that enables sharing of cloud resources. Cloud computing platform can become more flexible, extensible and reusable by adopting the concept of service oriented architecture [5].We will not need to unwrap the shrink wrapped software and install. The cloud is really very easier, just to install single software in the centralized facility and cover all the requirements of the company's users [1].

II. CLUSTER COMPUTING

A cluster is a group of linked computers, working together closely so that in many respects they form a single computer. The components of a cluster are commonly, but not always, connected to each other through fast local area networks. Clusters are usually deployed to improve performance and/or availability over that of a single computer, while typically being much more cost-effective than single computers of comparable speed or availability.It is a local network with high speed interconnections and more and more popular in modern high performance computing. They have such properties as obtaining high performance at a low price and good scalability. It is available and economical to solve large scientific and engineering problem on clusters. So, in nutshell, a cluster is a type of parallel and distributed system, which consists of a collection of inter-connected stand-alone computers working together as a single integrated computing resource [2].

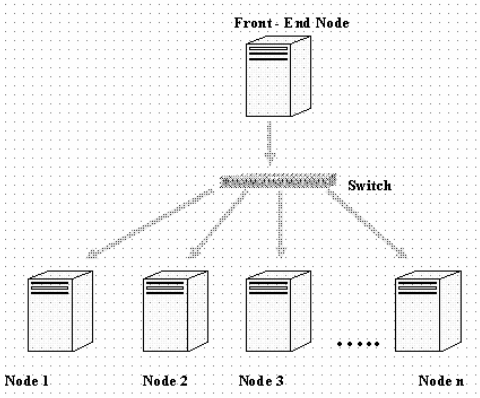

Fig. 1: Cluster Computing

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III. GRID COMPUTING

Grid computing is the combination of computer resources from multiple administrative domains applied to a common task, usually to a scientific, technical or business problem that requires a great number of computer processing cycles or the need to process large amounts of data. It is a type of parallel and distributed system that enables the sharing, selection, and aggregation of geographically distributed autonomous resources dynamically at runtime depending on their availability, capability, performance, cost and users quality-of-service requirements[2].It is a shared collection of reliable & unreliable resources and interactively communicating researchers of different virtual organizations (doctors, biologists). This system controls and coordinates the integrity of the Grid by balancing the usage of reliable and unreliable resources among its participants providing better quality of service. It can also be denoted by large-scale cluster computing, as well as a form of network-distributed parallel processing. It is a collection of servers that are clustered together to attack a single problem [9]. Grid computing is all about sharing, aggregating, hosting and offering service across the world for the benefits of mankind. So one can say a grid in need is a grid indeed.

The concept of Grid Computing will get cleared from the Fig 2:

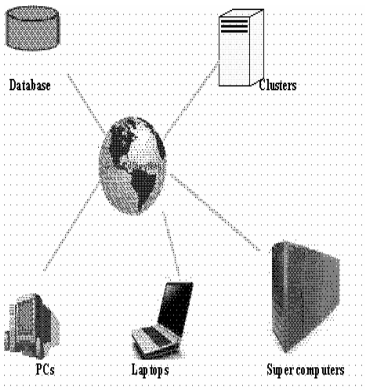


Fig. 2: Grid Computing

IV. CLOUD COMPUTING

The main idea behind cloud computing is to make applications available on flexible execution environments primarily located in the Internet.Cloud computing is of particular benefit to small and medium-sized businesses who wish to completely outsource their data-center infrastructure, or large companies who wish to get peak load capacity without incurring the higher cost of building larger data centers internally.Cloud computing is an extension of this paradigm wherein the capabilities of business applications are exposed as sophisticated services that can be accessed over a network. Cloud service providers are incentivized by the profits to be made by charging consumers for accessing these services. A Cloud is a type of parallel and distributed system consisting of a collection of inter-connected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service – level agreements established through negotiation between the service provider and consumers [2]. Basically a cloud is of two types: Public Cloud, Private Cloud

A public cloud sells services to anyone on the Internet. (the information and applications running on public cloud may be accessed from the internet).A private cloud is a proprietary network or a data center that supplies hosted services to a limited number of people (the information and applications running on the private cloud may be accessed from the intranet via a VPN connection between the internal datacenter and the "outsourced" infrastructure).

The services [11] provided by the cloud providers are:-

- SaaS – Software as a Service Network-hosted application(By Google Apps, Salesforce.com)
- DaaS – Data as a Service Customer queries against provider's database (By Google BigTable, Amazon simpleDB)
- PaaS– Platform as a Service Network - hosted software development platform(By Windows Azure, Google App Engine)
- IaaS – Infrastructure as a Service Provider hosts customer VMs or provides network storage(By Amazon web service EC2, Gogrid,Rackspace)
- IPMaaS – Identity and Policy Management as a Service Provider manages identity and/or access control policy for customer (By Rightscale, Appistry)
- NaaS – Network as a Service
- Provider offers virtualized networks (e.g. VPNs)

The concept of Cloud Computing will get cleared from the Fig 3:

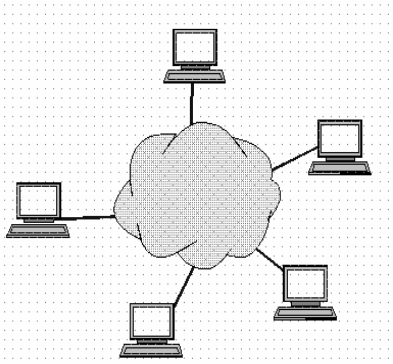
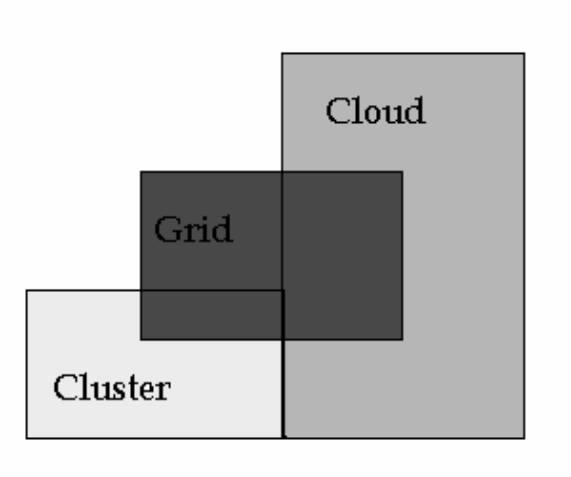


Fig. 3: Cloud Computing

DIFFERENTIATING CLUSTER, GRID AND CLOUD COMPUTING

Characteristics of Cluster computing 1:Tightly coupled systems : Single system image 3: Centralized Job management & scheduling system[8]	Characteristics of Grid Computing 1: Loosely coupled (Decentralization) 2: Diversity and Dynamism 3: Distributed Job Management & scheduling [8]	Characteristic of cloud computing 1: Dynamic computing infrastructure 2: IT service-centric approach 3: Self-service based usage model 4: Minimally or self-managed platform 5: Consumption-based billing
In cluster computing, a bunch of similar (or identical) computers are hooked up locally (in the same physical location, directly connected with very high speed connections) to operate as a single computer[7]	In grid computing, the computers do not have to be in the same physical location and can be operated independently. As far as other computers are concerned each computer on the grid is a distinct computer.[7]	In cloud computing, the computers need not to be in the same physical location.[7]
The cluster computers all have the same hardware and OS.	The computers that are part of a grid can run different operating systems and have different hardware	The memory, storage device and network communication are managed by the operating system of the basic physical cloud units. Open source software such as LINUX can support the basic physical unit management and virtualization computing.[6]
The whole system (all nodes) behaves like a single system view and resources are managed by centralized resource manager.	Every node is autonomous i.e. it has its own resource manager and behaves like an independent entity	Every node acts as an independent entity
The computers in the cluster are normally contained in a single location or complex.	Grid are inherently distributed by its nature over a LAN, metropolitan or WAN	Clouds are mainly distributed over MAN
More than 2 computers are connected to solve a problem[8]	A large project is divided among multiple computers to make use of their resources.	It does just the opposite. It allows multiple smaller applications to run at the same time.
Areas of cluster computing 1. Educational resources 2.Commercial sectors for industrial promotion 3.Medical research	Areas of Grid Computing 1.Predictive Modeling and Simulations 2.Engineering Design and Automation 3.Energy Resources Exploration 4.Medical, Military and Basic Research 5.Visualization[8]	Areas of cloud Computing 1.Banking 2.Insurance 3.Weather Forecasting 4.Space Exploration 5.Software as a service 6.PaaS 7.Infrastructure- as -a-Service

Differentiating among Cluster, Grid and Cloud computing with the help of figure 4:



V. BENEFITS OF CLOUD

Cloud computing is the next big future in computing. It has many benefits, such as better hardware management, since all the computers are the same and run the same hardware. It also provides better and easier management of data, since all the data is located on a central server, so administrators can control who have access to the files.

Cloud computing helps to increase the speed at which applications are deployed, helping to increase the pace of innovated networked computing. Service deployed applications; Cloud computing can be provided using an enterprise datacenter's own servers, or it can be provided by a cloud provider that takes all of the capital risk of owning the infrastructure.

Cloud computing incorporates virtualization, data and application on-demand deployment, internet delivery of services, and open source software. The combination of virtual machines and virtual appliances used for server deployment objects is one of the key features of cloud computing. Additionally, company's can merge a storage cloud that provides a virtualized storage platform and is managed through an API, or Web-based interfaces for file management, and application data deployments.

The benefits of deploying applications using cloud computing include reducing run time and response time, minimizing the purchasing and deployment of physical infrastructure.

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Cloud Computing allows business to increase IT capacity (or add capabilities) on the fly and in real time (Internet-enabled), without investing in new infrastructure, training new personnel or licensing new software, and as a pay-per-use service.

VI. CONCLUSION

The future for cloud computing is bright. The big companies in computers are throwing lots of resources into this. Company like Amazon DELL, HP and Intel etc sees a huge market for cloud computing in the future. One of the biggest benefits of cloud, of course, is costing less money than buying the application outright. The service provider can offer cheaper, more reliable applications / resources than organizations can buy themselves.

Although Cloud Computing providers may run afoul of the obstacles but we believe that over the long run providers will successfully navigate these challenges and set an example for others to follow, perhaps by successfully exploiting the opportunities that correspond to those obstacles.

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