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**International Journal of Modern Computer Science and Applications (IJMCSA) ISSN: 2321-2632 (Online) Volume No.3, Issue No.1, January, 2015 Comparison between Cloud Computing, Grid Computing, Cluster Computing and Virtualization**

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Abstract: Technologies like cloud, grid and cluster computing have all aimed at allowing access to large amounts of computing power in a fully virtualized manner, by aggregating resources as well as offering a single system view. This paper includes the introduction, characteristics, advantages, disadvantages, benefits and drawbacks of Virtualization, Cloud, Grid and Cluster Computing. Further this paper contains comparison between cloud, cluster and grid computing, comparison between grid and cluster computing and at last covering comparison between cloud computing and virtualization as well as comparison between grid and cloud computing. The aim of this paper is to show importance and comparison between virtualization, cloud, grid and cluster computing.

Keywords: Cloud Computing, Cluster Computing, Grid Computing, Virtualization

**I. INTRODUCTION**

Cloud computing [1, 11, 15] is a computing style in which flexible and scalable IT functionalities are delivered as a service to end users using Internet. Grid computing [22] has proven to be an important field focusing on the sharing of resources and provides solution to performance as well as capacity problems for several applications. Cluster Computing [16] mainly addresses the latest results in different fields that support High Performance Distributed Computing (HPDC). Using virtualization software (VMware), it became possible to execute one or many operating systems simultaneously in an isolated environment.

**II. CLOUD COMPUTING**

Cloud Computing [1] is a modern computing paradigm that providing IT infrastructure and essential services i.e. infrastructure as a service (IaaS), platform as a service (PaaS), software as a service (SaaS) etc. Cloud computing [2] is an important model for enabling ubiquitous, convenient, on- demand network access to a shared pool of configurable computing resources like networks, servers, storage, applications, and services that can be rapidly provisioned as well as released with minimal management effort.

**III. C**

**LOUD**

**Advantages Disadvantages**

Shared Resources Internet Required

Automatic Software

Integration

Dependency and

vendor lock-in

Cost Efficient

Non-Interoperability

Easy Access to

Information

Less Reliability

Quick Deployment Technical Issues

Almost Unlimited Storage Security in the Cloud

Backup and Recovery

Prone to Attack

Better Hardware

Management

Increased

Vulnerability

Mobility Less Control C

**OMPUTING**

**C**

**HARACTERISTICS**

Versatile Compatibility No always many room The essential characteristics of cloud computing can be elaborated as follows [11]:

1. On-demand self-service

**Table1-1: Advantages and Disadvantages of Cloud Computing**

2. Broad network access

**IV. B**

ENEFITS OF 3. Resource pooling 4. Rapid elasticity 5. Measured service

**C**

**LOUD**

**C**

OMPUTING Cloud computing [3] increases scalability, efficiency, helps improve cash flow as well as offers many more benefits such as:

1. Disaster recovery 2. Flexibility

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3. Increased Scalability 4. Metered Service 5. Increased collaboration 6. Faster Deployment 7. Resource Pooling 8. Automatic software updates 9. Inherited Resiliency 10. Highly Automated

**V. D**

**RAWBACKS OF**

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**Advantages Disadvantages**

Can solve larger, more complex problems in a shorter time

Grid software and standards are still evolving

Reliability High Internet

Connection Required

**C**

**LOUD**

**C**

**OMPUTING**

1. Constant Internet Connection 2. High Speed Internet Required

Easier to collaborate with other organizations

3. Data Stored is not secure 4. Limited Features

**VI. G**

**RID**

Non-interactive job submission Resource Balancing Not Stable

Access to Additional Resources

Different C

OMPUTING In grid computing [3, 17], individual users obtain computing

Administrator Domains

resources like storage, applications, data, processors etc. on

Make better use of existing demand with limited knowledge of where the resources are

hardware located. Grid computing [1, 4] captures the basics of distributed computing that involves coordinating as well as sharing computing, data, application and storage or network resources across dynamic and geographically dispersed organization. The management features [14] of grid software enables the linking of computer resources together in a way that lets an individual use a single machine to leverage as well as access the collected power of all the machines within the grid computing system. The purpose of grid computing [5] was to allow access to computer based resources like from CPU cycles to data servers in the same manner as real world utilities [23].

**VII. GRID CHARACTERISTICS**

Grid computing [6, 18] is applying the resources of many computers in a network to a single problem at the same time - usually to solve a scientific as well as technical problem that requires a great number of computer processing cycles [22]. The essential characteristics of grid can be elaborated as follows [1, 2, 3]:

1. Resource sharing 2. Geographical distribution 3. Heterogeneity 4. Large scale 5. Multiple administrations 6. Resource coordination 7. Transparent access 8. Dependable access 9. Consistent access 10. Pervasive access 11. Decentralization (Loosely coupled) 12. Dynamism and Diversity 13. Distributed Job Management & scheduling

Learning curve to get started

Computers working

together

Technology support to

utilize the grid

Unused computing

capacity is effectively used

Some applications

cannot be parallelized

**Table1-2: Advantages and Disadvantages of Grid Computing**

**VIII. B**

**ENEFITS OF**

**G**

**RID**

**C**

**OMPUTING**

1. Enables applications to be easily scaled 2. Better utilization of underused resources 3. Enables the linking of cheaper computers together, instead of spending a lot of money on one machine 4. Technologies being used are open source, trust and

transparency is encouraged 5. Increased reliability of computing 6. Allows the sharing of computer resources across

networks 7. Parallelization of processing 8. Resource balancing

**IX. D**

**RAWBACKS OF**

**G**

**RID**

**C**

**OMPUTING**

1. Proprietary approach should be eliminated 2. Reliability and Complexity 3. There is a single point of failure if one unit on the grid

degrades

**X. G**

**RID**

**U**

SES Grid [1,2,3] is a computing paradigm for providing computational resources for grand-challenge applications as well as it is an infrastructure that bonds globally remote and diverse resources in order to provide computing support for a wide range of applications. Grid [7] not defined in terms of

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applications (as usually found in the literature) but rather of the computing support the grid provides such as:

1. Distributed supercomputing 2. High-throughput computing 3. On-demand computing 4. Data-intensive computing 5. Collaborative computing 6. Multimedia computing

**XI. C**

**LUSTER**

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developed by Google and also used by many organizations worldwide. Ganeti is very lightweight, simple to install as well as manage, and it does not demand any special storage hardware.

**XIV. BENEFITS OF VIRTUALIZATION**

Virtualization [10] is a great innovation in technology world and the end of 2012, roughly 70% of all companies were

**C**

**OMPUTING**

running at least few application workloads as virtual instances. Access to the virtual resources is controlled by a Virtual Cluster computing [8, 18] is the growing field to link

Machine Manager (hypervisor). Some of the benefits of together inexpensive commodity computers as well as helps to

virtualization include such as: find an answer to many problems. Cluster programmers [13]

1. Testing and learning require mainly the environment so that they can easily allow

2. VMs are portable them to take the advantage of the clusters performance

3. Decreased hardware investment capabilities. Locality and consideration [21] of data distribution

4. Lower maintenance costs are primarily to the success of any cluster. Cluster [9] is the

5. Improved Performance and disaster recovery journal of applications and networks that are parallel

6. Lower energy consumption, environment friendly processing distributed computing. Cluster is easily defined as

7. Easier Migration into the cloud the technique of linking between two or more computers into a

8. Easily host a guest operating system(VM) local area network.

9. Create lots of webservers

**XII. C**

**LUSTER**

**C**

**OMPUTING**

**C**

**HARACTERISTICS**

**XV. D**

**RAWBACKS OF**

The essential characteristics of cluster computing can be elaborated as follows [11]:

1. Tightly coupled systems 2. Single system image 3. Centralized Job management & scheduling system

**Advantages Disadvantages**

Reducing cost Programmability Issues

Manageability Problem in Finding Fault

Single System Image Difficult to handle by a

Layman High Availability Difficult for developing software for distributed system Improves network technology Easily accessed and

applied to secret data

**Table1-3: Advantages and Disadvantages of Cluster Computing**

**XIII. V**

**IRTUALIZATION**

Virtualization [10] is a building block in today’s computer infrastructures. Virtualization [19] means to create a virtual version of a resource or device, like storage device, server, network or even an OS where the framework divides the resource into one or more execution environments. Ganeti [12] is an important cluster virtualization system

**V**

**IRTUALIZATION**

1. High Risk in Physical fault 2. Single point of failure 3. Powerful machines 4. Lower performance 5. Specific applications that can't be virtualized XVI. COMPARISON BETWEEN CLOUD, CLUSTER AND GRID COMPUTING

**Cloud Cluster Grid**

On-demand self- Service

Yes No No

Broad network access Yes Yes Yes

Resource pooling Yes Yes Yes

Rapid elasticity Yes No No

Measured service Yes No Yes

**Table1-4: Comparison between Cloud, Cluster and Grid Computing**

**XVII. C**

**OMPARISON**

**B**

**ETWEEN**

**G**

**RID**

**C**

**OMPUTING AND CLUSTER COMPUTING**

**Grid Computing Cluster Computing**

Heterogeneous Homogenous

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Not rapid elasticity Rapid elasticity The computers that are part of a grid can run different hardware as well as have different OS

The cluster computers all have the same hardware and OS

Distributed computing architecture

Grid can make use of spare computing power on a desktop computer

Client-server architecture

The machines in

Used for specific purposes Used for business and a cluster are dedicated to

public needs work as a single unit as well as nothing else Grid are inherently distributed by its nature over a LAN,

Grids evolve slower than cloud

MAN or WAN

The computers in the cluster are normally

Clouds evolve faster than grid

contained in a single location

Level of expertise to use a grid is higher than cloud Every node is autonomous (it has its own resource manager as well as behaves like an independent entity)

Level of expertise to use a cloud is lower than grid Whole system (all nodes) behave like a single system view as well as resources are managed by centralized resource

It is the base concept of cloud computing

manager

**Table1-5: Comparison between Grid and Cluster Computing**

**XVIII. C**

**OMPARISON**

Cloud offers more services than grid computing

A grid is not necessarily a cloud or part of a cloud

A cloud would usually use a grid

**B**

**ETWEEN**

**C**

**LOUD**

**C**

**OMPUTING A**

**ND**

**V**

**IRTUALIZATION**

**Grids tends to be more Cloud Computing Virtualization**

loosely coupled,

Delivery of computing resources as a service to end- users over a network

heterogeneous, and geographically dispersed compared to conventional cluster computing systems

In fact almost all the services on the Internet can

Part of the logical infrastructure

be obtained from cloud, e.g. web hosting, multiple OS, DB support and much Cloud treats computing as a utility rather than a specific technology

itself does not provide the customer a self-service layer and without that

more.

Grid computing federates layer you cannot deliver

resources located within

An approach for the delivery

compute as a service

different organizations

of services to an end-user

Cloud computing is typically provided within a

One possible service that

single organization could be delivered

(Amazon), that simplifies Cannot exist without virtualization – at least, not in its current format

Exist without the cloud

many aspects, particularly security, availability and

Cloud computing takes the use

heterogeneity

of those resources to another level by delivering access to those components on-demand

Failure management (Selfhealing) is limited (often failed tasks/applications are as a service, thus reducing

restarted) complexity for the end user, cost and burden

Virtualization by itself allows an organization to utilize and effectively use its IT resources

**Table1-6: Comparison between Cloud Computing and Virtualization**

**XIX. COMPARISON BETWEEN GRID COMPUTING**

**A**

**ND**

Strong support for failover and content replication. VMs can be easily migrated from one node to other Resource management is distributed

Resource management is centralized/distributed

**Table1-7: Comparison between Grid and Cloud Computing**

**C**

**LOUD**

**C**

**OMPUTING**

**XX. CONCLUSION**

In this paper, we have presented a detailed comparison on the Grid Computing Cloud Computing

cloud, grid, cluster computing and virtualization [1]. The Resources are pre-reserved Resources are on-demand

concept of cloud computing is becoming more and more popular and it is in the beginning stage. Reputed companies are providing all types of cloud computing service, from software

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application to net storage and mail filter and we believe cloud computing will become main technology in our information life. The dream of grid computing [20] will be realized by cloud computing. Grid, cloud and more computing appears to be a promising model especially focusing on standardizing APIs, security, interoperability, new business models, as well as dynamic pricing systems for complex services. So there is a large scope for further research in these areas [1].

**A**

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