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Exploring the Power of Cloud Computing Over Grid Computing

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***Abstract*-In today's network world, the most advanced and recent technology is the Cloud computing. Clouds can be thought as the new generation of Grid Computing. Clouds generally consist of data centres that are owned by the same organization. The homogeneity within each data centre in the infrastructure is the main feature for the cloud computing compared to grid computing. This paper not only defines cloud but provides the different components of clouds. It also provides the different services provided by Clouds and how Cloud's cost definition differs from that of Grid computing. It further defines the Grid computing with its main characteristics. Main focus of this paper is to compare the cloud computing with the earlier generation technology like Grid computing by high lighting the main differences as well the similarities between them. At the end, this paper also focuses the advantages of using Cloud Computing and its future prospects.**

Keywords: Cloud computing, Grid Computing, IaaS, SaaS, PaaS, SLAs

I. INTRODUCTION:

The Cloud Computing has been emerged as a new promising paradigm in the modern era that delivers IT services as computing utilities for different academic institutions, enterprises and companies. It caused major influences in the IT industries. As per the definition in IBM [1], a Cloud is a pool of virtualized computer resources that performs a variety of different tasks and allows them to be deployed and scaled-out through the virtual or physical machines. It supports redundant, self-recovering, highly scalable programming models and resource usage monitoring in real time to enable rebalancing of allocations when required. Today many organizations want to decrease the need of hardware maintenance and are planning to use virtual data centres for the management of infrastructure. This kind of infrastructure is reducing the problems that are generated in the deployment of services. For example, many users may sometime want to deploy different application, regardless losing flexibility and the cost of deployment. The reason of designing such clouds for providing services to users and providers often need sharing their capability and resources. Here the clouds may have same vision as of grid computing but still there are highly considerable differences. A grid system that has the ability to manage and organize different resources and services that are distributed across several domains, utilize protocols and interfaces and supply high quality of service [2]. Grimshaw et.al. [3] defines grid computing as "coordinated resource sharing and problem solving in dynamic, multi-institution virtual organizations". Today many organizations such as Amazon, Yahoo, Sun and Google provides Cloud Computing services. Many individual users also adopted it through these organizations. But Amazon played a very important role in the development of cloud computing. Amazon modernized their own internal data centres because of which their internal efficiency increased significantly. In 2005, Amazon developed their own cloud computing system called Amazon web services. Amazon was the first organization to provide cloud computing facilities.

In this paper first the definition of cloud computing and grid computing is defined. Then in the subsequent sections their similarities and differences are also defined and in the end advantages and the future prospects of cloud computing is discussed.

II. CLOUD COMPUTING

Cloud Computing is a technology which provides us a facility to use and download many application from the server using internet. Basically cloud computing technology is consisting of three main components [4]

A) Cloud Computing Service Providing Company
B) High Capacity Server Machine (Storage) and Internet
C) Users

The cloud computing service provider companies develops some useful applications and uploads it in the internet. They store these applications in high capacity server machine then advertise these applications to reach to the end users. End users use; download these applications as their requirements. The end users' needs only internet connection, they login in the server and can use their services.

Works in Cloud Computing can be organized in the form of different types of services. These are some services offered by cloud computing [5]:

A) **Infrastructure as a Service (IaaS):** Hardware resources such as storage, high speed processor and large capacity memory are offered as infrastructure services by cloud.
B) **Software as a Service (SaaS*):*** Software applications are offered as services in internet. User can download and use that software. Users don't need to purchase software packages from third party dealer in high cost. Very good example is Google web-based applications word processor and spreadsheet.
C) **Platform as a Service (PaaS):** Here the cloud offers the application development environment or platform for entire development (life cycle) of any software. In other words, design, implementation, debugging, testing, deployment, operation and maintenance are required steps for software development and cloud computing provides all facilities to perform all the above steps.

III. GRID COMPUTING

A grid is a system that has the ability to manage and organize resources and services that are distributed across several control domains, utilize protocols and interfaces and supply high quality of service [2]. Grimshaw et.al. [3] defines grid computing as "coordinated resource sharing and problem solving in dynamic, multi-institution virtual organizations".

IV. CHARACTERISTICS OF GRID [6]:

Various definitions and characteristics have been evolved while going through different grid literature sources. Some of the important characteristics are given below:

A) **Huge Size**: A grid's size may vary from just a few resources to millions. So as the grid size increases there may be problems related to potential performance degradation [7].

B) **Distribution of resources**: A grid's resources may be distributed to a number of places.

C) Heterogeneity: A grid generally hosts hardware and software resources that can contain data, files, software components or programs to sensors, scientific instruments, display devices, personal digital organizers, computers, super-computers and networks [8].

D) Sharing Of Resources: Resources in a grid generally belong to many different organizations that allow the users of same as well as other organization to access them. So non local resources can thus be used by other applications, promoting efficiency and reducing costs.

E) Involvement of multiple administrations: Every organization may set up 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 of all different policies.

F) Reliable and regular access: A grid should be built with standard protocols, services, and inter-faces which hides the heterogeneity of the different resources while allowing its scalability. Without such standards, application development and pervasive use of grid would not be possible.

G) Pervasive access: A grid must grant access to available resources by adapting to a dynamic environment in which resource failure is common place. This imply that resources are not everywhere or universally available but that the grid must modify its behavior as to extract the maximum performance from the available resources.

V. SIMILARITIES BETWEEN CLOUD COMPUTING AND GRID COMPUTING

Cloud and Grid Computing both are similar technologies and they share lots of issues among themselves. Some of the important things that both technologies have in common are:

A) In both the technologies, data are distributed to many computers in order to achieve high scalability and good performance [9].

B) People are generally afraid of sending important and sensitive data through a large number of distributed computers [9].

C) Data should be moved repeatedly to distant computers because the data is not always available everywhere and sometimes it is necessary to make this data available [9]. This movement generates the bottleneck of the process.

D) Data can be requested from anywhere and anytime regardless of its location.

E) Cloud and Grid computing, both provide service-level agreements (SLAs) for guaranteed on time availability up to 99 percent. If the required service goes below the level of the guaranteed on time service then the consumer will get the service credit for receiving data late

F) In both technologies, the systems must be able to determine the number of unused resources [1] so that load can be shared to equally to overcome the bottleneck

VI. THE BASIC DIFFERENCES BETWEEN CLOUD AND GRID COMPUTING

Before the advantages of grid over cloud computing is discussed, lets us see some points that clarify what are the main differences between Cloud and Grid computing:

A) Grid computing normally runs on heterogeneous computers but Cloud computing normally runs in a set of homogeneous computers[9].

B) Grid computing is generally focused on intensive calculus whereas Cloud Computing offers two types of calculus: intensive and calculus [1].

C) Grid computing is an open-source whereas Cloud Computing is not [10]. This creates interoperability problems between today's Clouds.

D) Generally Grids use a batch-scheduled compute model, whereas in Cloud Computing the users share all the resources at the same time. So latency sensitive applications, which are generally executed in Grids, could not be executed in Cloud Computing [9].

E) Grids dependency on virtualization is comparatively less than that of Cloud.

F) Grids support for provenance is more than that of Cloud Computing.

G) Grid's support for high performance computing is better than that of cloud computing.

H) Cloud computing has only one research community and a single common group of administrator that take care of the entire Cloud whereas Grid has multiple research communities (including user accessing resources from varied administration domains), and is distributed and grouped into multiple virtual organizations[10].

I) Cloud computing is funded mainly at local level by its users whereas Grids are funded at local, national and international levels.

J) In cloud computing only user interface is shared and resource interfaces are hidden from the user where as in Grid computing both user and resource interface are

shared and it allow providers to connect their resources.

K) In Cloud Computing, storing of files is suitable whereas in Grid Computing even a small file cannot be stored suitably [1].

L) In Cloud computing resources are abstracted and virtualized and so the trust model which is based on identity delegation does not exist. But in Grid computing this trust do exists and here user can access and browse resources which are not highly abstracted and virtualized at different Grid sites.

VII. PROBLEMS FACED WHILE IMPLEMENTING CLOUD COMPUTING AND GRID COMPUTING

A) **Strategy of threshold:** Suppose consider a situation where the demand increases or decreases with time. For example in program of credit card verification in the cloud, when the sales demand increases then there is need of creating more instances of resources and when it decreases then the resources instances will be recycled and reassigned to other applications. Now to test this program before transferring to real production environment there is need to develop, improve and achieve a strategy of threshold in the feasibility test stage. Again there is need to check whether this strategy could find the sudden increase in the demand to create more instances in the stage. Here it can also be explored to find how to recover the unused resources and transfer it to other work.

B) **Issue of Interoperability**: In case of outsourcing an application with cloud computing provider, it is difficult to turn to other providers who adopt proprietary API or has different import and export data formats. This facts result in the issue of interoperability between the cloud computing providers and it is possible to change the data format or application logic. Since there is no cloud computing industry standard of data export and import or API, so Amazon and IBM web services launched cooperation in order to achieve the interoperability[11]

C) Implicit cost: Cloud computing cannot exactly predict how much cost will be implied. It depends on the various factors. For example if an organization uses the storage space provided by the different service provider for storing their database applications which may contain data upto tera byte(TB) then the cost of network will be very high. This cost is even higher than the cost of purchasing new infrastructure, new softwares and training new employees. Let us take another example where an organization is at far distance from the service providers then there may be long delay due to high traffic situations.

D) **Unusual Behavior:** Let us suppose that the verification of credit card applications runs well in the organization then it need to be tested the same applications in the cloud by testing its feasibility for unexpected behavior. For example to see how the credit card application is verified, how the resources are distributed, how the idle resources are released and other tasks are performed, the application must be verified first. If the verification of credit card and releasing of idle resources results in the unusual results then we need to solve these problems before putting them in the cloud.

E) **Security Issues**: There are many aspects of data security on the clouds. One aspects of security is to encrypt the data with a suitable algorithm on the local system and then access that data on a remote server of the cloud with a suitable decryption key. If the data that have been accessed is read properly then the encryption key can be destroyed and if it is not read then the providers can use their encryption key for the same. For this to happen the providers need to learn algorithms. Another issue is the potential problems in the cloud. In order to protect data on cloud, one may need to manage his private key and ask for the management of the private key to provider. If agreed then the management will provide the certificate for the same.

VIII. ADVANTAGES OF CLOUD COMPUTING

A) **Software development in the cloud:** To develop software for high end database, the most appropriate option is to use the cloud server pool within the organizational data center. To see how a project manager can better controls cost, how he distributes resources and how security problems are managed in the cloud, Amazon web services temporary expansion resources can be used. The project managers then can distribute the different hardware resources to the different cloud types like product cloud; test cloud and web develop cloud. But the cost of these clouds is not the same. Here the development cost of cloud per unit time may be lesser than the product cloud because security and other additional features are distributed in the product cloud [12]. The project can be restricted to the specific by the managers. For example the service part of the product cloud can be used for product configuration but the service of the develop cloud is the only development. If the cost becomes too high then the managers can spend less to use Amazon temporary extension resources till the data recovery issues and the securities have been resolved.

B) **Cloud computing is environment friendly:** One important advantage of cloud computing is that it is environment friendly. First of all the hardware on which the organizational data center needs to run the applications is reduced and then with help of cloud computing, hardware cost can be reduced and the power required by the temperature[13] can also be reduced. Integrating these systems with remote server can also be managed more effectively. Secondly the cloud computing technology also improves the telecommunication technology. For example remote printing and file transfer may also reduce the needs of office space. Furthermore purchasing new furniture and out of old one, cleaning office space and others may also reduce the need to drive to work and some amount of pollution.

IX. CONCLUSION

In this paper lot of similarities between Grids and Clouds have been shown in terms of vision, architecture and technology. Also many differences between them in terms of security, business model, programming model, data model, compute model, applications and abstractions, have been shown. Challenges and opportunities in both the fields also have been identified. It is believed that such a close comparison between them can help the two communities to understand, share and evolve infrastructure and technology within and across, and accelerate cloud computing from early prototypes to production system. Based on our future demands, here some predictions are made based on the belief that the economics of computing will look more and more like those of energy. It is thus assumed that neither the computing grids of tomorrow nor the energy will be like yesterday's power grid. Both will move towards a mix of micro production and large utilities with increasing numbers of small scale producers like biomass, solar, wind etc. for energy and embedded processors and local clusters for computing, coexisting with large scale regional producers and the load being among them dynamically. In building such distributed Grid or Cloud there is a need to support on demand provisioning and configuration of integrated virtual systems that provides the precise capabilities needed by an end user. To fulfill this there is need to define some protocols that allow service providers and users to discover and pass of demands to other providers, to make payment and monitor and manage reservations. Also there is a need for some tools for managing both the underlying resources and the resulting distributed computations. There is need for the centralized scale of today's cloud utilities and the interoperability and distribution of today's grid facilities. It is sorry to say that till date, the methods used to achieve these goals in today's commercial clouds have not been open for general purpose, rather than they have been mostly proprietary and specialized for the specific internal uses (e.g., large-scale data analysis) of the companies that developed them. The purpose that might want to facilitate interoperability between providers has not yet surfaced. Grid protocols and technologies that precisely define these issues should be considered. Some of the required tools and protocols should come from the smart people from the industry like Google, Amazon, Yahoo, IBM, Microsoft etc. Others should come from the smart people from academia and government labs. Some other should come from those creating whatever we call this stuff after Grid and Cloud. It will be interesting to see to what extent these different communities manage to find common cause, or instead proceed along parallel paths.

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