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Similarities and Contrast between Grid Computing and Cloud Computing

KEYWORDS: Virtualization, SaaS, on-demand services, Client-Server Model

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ABSTRACT *Grid and Cloud both have similarities like both are used to share recourses e.g. computational power, storage, application, equipments and many more. That don't mean both are equals. In this paper we have discussed about Grid Computing and Cloud Computing. We have differentiated the Grid Computing and Cloud Computing. This paper contains what is Grid Computing and Cloud Computing, architecture of both, different components of these architectures, and many more similarities and contrast between Grid Computing and Cloud Computing.*

I. Introduction

Grid Computing:

Grid computing [1,3,4] is based on the philosophy of sharing information and power, which gives us access to another type of heterogeneous resources which are geographically separated.

Grid provides the sharing of:

- Computational resources
- Storage elements
- Specific applications
- Equipment
- Other

Thus, Grid is based on:

- Internet protocols
- Ideas of parallel and distributed computing

Cloud Computing:

Cloud Computing [8] is a large-scale distributed computing model that is driven by economies of scale, in which a group of capture, virtualized, dynamically scalable, managed computing power, storage, platforms and services are available on request to external customers over the Internet

2009-2010 has been the year for new computing technology i.e. Cloud Computing, as was the year 2007-2008 for SaaS-(Software as a Service). Cloud Computing and Grid Computing may be considered opposites in terms of Functioning. Cloud Computing integrate everything into one place whereas Grid Computing divides everything.

In Grid computing [10], two or more computer coordinates to solve a problem together. It often used for problems involving a lot of number crunching, which can be easily parallelisable.

In Cloud computing, an application does not access resources it requires directly rather accesses them through service or like that. So instead of talking to a specific hard drive for storage and a specific CPU power for computation, etc. it send request to some service that provides these resources. This service then maps any requests for resources to its physical resources, to provide for the application. Generally the service has access to a large amount of physical resources, and can dynamically assign them as they are needed.

II. History

In the 1990s, the term Grid was coined to describe technologies that allow consumers to obtain computing power on demand. Ian Foster [1] and others postulated that the standardization of protocols used to apply computing power could encourage the creation of a grid, similar to the shape and utility power grid. The researchers then developed these ideas in many exciting ways, for example by producing large-scale federated systems (TeraGrid, Open Science Grid, caBIG, EGEE, Earth System Grid) which provide computing power is not just, but also data and software on demand. Standardization bodies (eg, OGF, OASIS) have defined standards.

Is "Cloud Computing" just a new name for the grid? In information technology, where the technology scales by an order of magnitude, and in the process reinvents itself every five years, there is no simple answer to these questions.

Cloud Computing not only overlaps with Grid Computing, it is indeed evolved from Grid Computing and relies on Grid Computing as its backbone and infrastructure support. The outcome was the result of a shift of an infrastructure that delivers storage resources and computing (as is the case in the grids) to that based economy to provide the most resources abstract and services (as is the case in the clouds). Regarding utility computing, this is not a new paradigm of IT infrastructure, but rather, it is a business model in which computing resources such as computation and storage, are packaged as services counted similar to a physical public utility such as electricity and public switched telephone network. Utility computing is normally implemented using other infrastructure (grids, for example) with the accounting and additional monitoring services. Cloud infrastructure can be used internally by a company or exposed to public utility computing.

See Figure 1 for an overview of the relationship between clouds and other areas it covers with. Web 2.0 covers almost the entire spectrum of service-oriented applications, where Cloud Computing is the next large scale. Cluster Computing and Supercomputing were more focused on non-traditional service. Grid Computing overlaps with all these areas where it is generally considered less important than supercomputers and clouds.

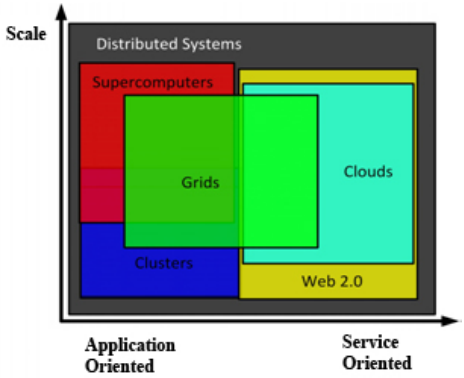

Figure 1: Relationship between grid, cloud and other domain

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III. Grid Computing and Cloud Computing Architecture difference

Architecture:

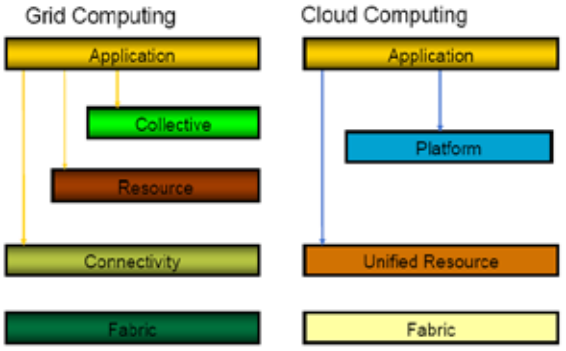

Figure 2: Grid Computing and Cloud Computing Architecture

Followings are the differences related to architecture of grid and cloud [2].

A. Business model:
Grid computing:
- project-oriented, in which it is possible to spend an amount of service units, generally CPU hours
- Example: TeraGrid, proposals for the increment of computational power

Cloud computing:
- customers pay providers on a consumption basis
- Example: EC2 from Amazon, S3 from Amazon

B. Resource management:
Grid computing:
- Batch-based computing model: Use of LRM (local resource managers), such as Condor, PGS or Sun Grid Engine.
- Data model: location transparency, use of a distributed metadata catalog. Data storage usually depends on a shared file system (PVFS, Lustre).
- Virtualization is not so important, although there are some initiatives
- Widely use of Ganglia as monitoring system

Cloud computing:
- Computing model: Resources in the cloud shared by all users. More number of users.
- Data model: Google's MapReduce system running on top of the Google File system
- Virtualization is key in Cloud Computing
- Difficult to obtain a high level of detail in monitoring. In the future, clouds will be self-maintained.

C. Programming model:
Grid computing:
- MPICH-G2
- GridRPC
- Workflow systems
- WSRF

Cloud computing:
- MapReduce model:
- "Map": Applying a specific operation to a set of items, obtaining a new set of items
- "Reduce": Aggregation on a set of items
- Hadoop: Open source implementation of the MapReduce model
- Scripting (Java Script, PHP, Python)

D. Security model:
Grid computing:
- GSI

Cloud computing:
- Simpler model and less secure
- Use of SSL and Web forms
- A challenge not solved in clouds

IV. Other Differences

They share many goals. They are different in many aspects. But, they are complementary. Cloud computing is indeed evolved out of Grid Computing and relies on Grid Computing as its backbone and infrastructure support [1]

TABLE 1. Similarities and Contrast between Grid Computing and Cloud Computing

Feature	Grid Computing	Cloud Computing
Goal	Collaborative sharing of resources	Use of service
Principle	Grid needs processing from you	cloud does the processing for you
Workflow management	In one physical node	In EC2 instance (Amazon EC2+S3)
Functioning	Grid Computing divides everything	Cloud Computing Assimilates everything into one place
Level of abstraction	Low (more details)	High (eliminate details)
Critical object	Computer resource	Service
Multitask	Yes	Yes
Dependency	A grid is not necessarily a cloud or part of a cloud	A cloud would usually use a grid
Transparency	Low	High
Security	Low (grid certificate service)	High (Virtualization)
Ownership	Multiple	Single
Interconnection network	Mostly internet with latency and low bandwidth	Dedicated, high-end with low latency and high bandwidth
Resource Sharing	Collaboration (VOs, fair share)	Assigned resources are not shared.
Resource management	Distributed	Centralized/Distributed
Allocation /Scheduling	Decentralized	Both centralized/decentralized
Type of service	CPU, network, memory, bandwidth, device, storage, etc	IaaS, PaaS, SaaS, Everything as a service
Uses	Grids are used as computing/storage platform.	Cloud computing offers services. We can say that cloud computing is higher-level grid
High Level Services	Plenty of high level services.	No high level services defined yet.
Example of real world	SETI, BOINC, Folding@home, GIMPS	Amazon Web Service (AWS), Google apps
Standardization	Standardization and interoperability	Lack of standards for Clouds interoperability

Above table 1 represents the similarities and contrast between Grid Computing and Cloud Computing.

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Cloud computing [5] is based on the principle of letting others do the work for you, technically, it means running all your applications, documents and data from a third party server. E.g. we have been using the applications on the net and store our data online, so that the cloud computing not only stores our data online and provide us with the applications, but it also makes the treatment for us. Online applications that we used previously, local processing used to a certain extent, but provides its own cloud processing.

Now, the individual point of view this may not be of great significance, but for larger organizations, which have huge data networks, Cloud is a boon in a way that saves the hassle with maintenance, s/w & h/w update and other material costs, plus it saves people time & IT help them cope with WHAT then to think about HOW.

Many companies like IBM, Microsoft and Google providing cloud-based services.

European Union is conducting research on the possibility of providing cloud-based games and other on-demand services.

Grid Computing is something exact opposite, cloud does the work for you, Grid requires work from you. Grid computing is mostly used by scientists and research organizations and universities based on the different area of the world.

It is based on the client-server model. In a Grid, there are several computers thousand (maybe more) as nodes connected to a central server (maybe more than one server).

Data processing such as scientific analysis or research-based disease is divided and distributed among the nodes. The node provides the processing power, while the server distributes just assimilates and manages the process.

A single grid can provide computing power equivalent to a supercomputer, such as The World Community Grid, which studies on cures for diseases such as cancer, AIDS, etc. has 475000 registered users and Computer power equal to about 3.3 teraflops. Grid Computing concept has also been used in the underworld to steal data and spread malware

V. Conclusions

There are many similarities between Grid and Cloud computing, both systems share the same basic goal to reduce the cost of computing, improve reliability and improve flexibility by turning the computers we buy something and exploit ourselves to something that is operated by a third party

They share many goals. They are different in many ways. But, they are complementary. Cloud computing is actually evolved from Grid Computing and is based on Grid Computing as its backbone and infrastructure support.

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