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A STUDY ON CLOUD COMPUTING IN DISTRIBUTED SYSTEMS

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Abstract

Cloud computing is the emerging trend in the field of distributed computing. Cloud computing is evolved from grid computing and distributed computing. Cloud plays an important role in huge organizations in maintaining huge data with limited resources. With the development of parallel computing, distributed computing, grid computing, a new computing model appeared. The concept of computing comes from grid, public computing and SAAS. The basic principles of cloud computing is to make the computing be assigned in a great number of distributed computers, rather than local computer or remoter server. The two key advantages of this model are ease-of-use and cost-effectiveness.

Keywords*:* Cloud Computing, Grid Computing, Eucalyptus, Architecture, Deployment Models.

1. INTRODUCTION

Cloud computing is a style of Grid Computing where dynamically stable and virtualized resources are available as a service over the internet. IT services are hosted in the data centers and commercialized. This is a form of specialized Distributed and Utility Computing. In Grid and cloud computing the number of servers are linked together to share a computing task.

For many organizations, cloud computing serves as a secure and shared space in which to share information and do business with industry partners. Distributed systems in general promise to boost the effectiveness of specific applications by running them across multiple machines.

They can also lower the cost of computing through utility computing services, where users pay for their usage of the larger distributed system. The benefits of this model, sometimes called utility computing or software as a service (SaaS) is that it means data and applications can be available from anywhere, generally via a browser. Also, users can access more power than they could buy themselves, because computing resources, such as processing, networking and storage, are pooled.

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2. EUCALYPTUS CLOUD COMPUTING ARCHITECTURE

Eucalyptus cloud computing architecture is highly scalable because of its distributed nature. The Cloud level of the computing architecture is comprised of only two components and while used by many users, the transactions at each component are typically small.

The Node level may have many components, but each component only supports a few users, even though the transactions are larger. This distributed cloud architecture is flexible enough to support businesses of any size.

2.1 components of Eucalyptus

The four components of Eucalyptus that have their own Web-service interface for communication with other components are described as follows

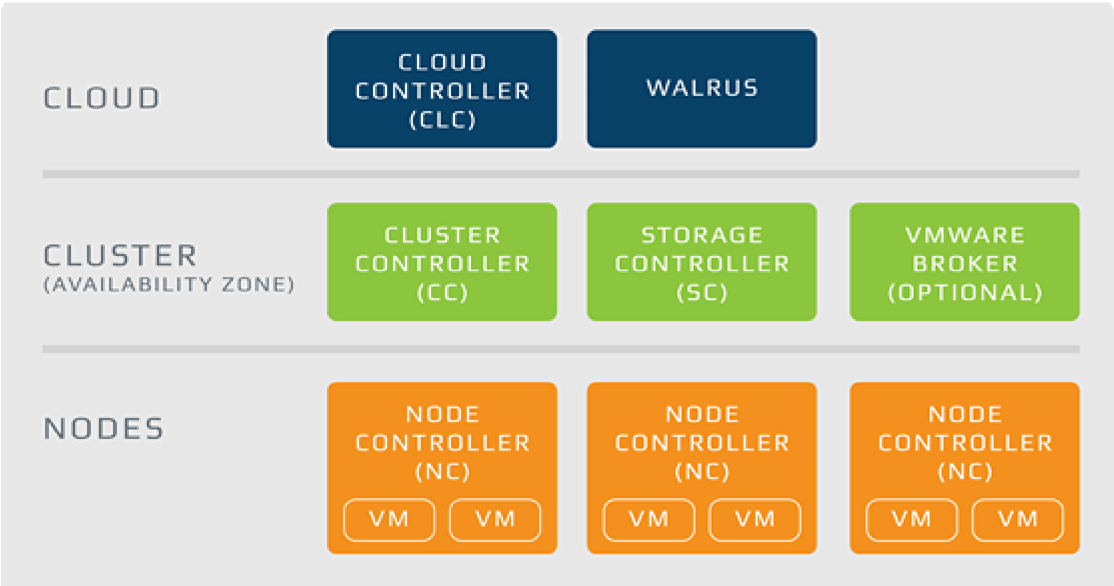

Figure 1 Design of Eucalyptus

2.1.1 Node Controller:

Every node that runs Virtual Machine instances has an execution of Node Controller, NC. An NC is expected to reply to the describe Resource and describe Instance queries from Cluster Controller (CC) about the node's number of cores, memory size or disk space available; and handle its subsequent control requests of run Instance by creating virtual network's endpoint and instructing hypervisor to run instance, and terminate Instance by instructing hypervisor to end VM, rupturing network end-point and cleaning the local data.

2.1.2 Cluster Controller:

CC is the head of many NCs forming a cluster. It has the job of connecting the Cloud Controller, CLC to the NCs. It distributes the general requests of CLC to all nodes in the cluster and also trickles down the specific requests of CLC to a set of nodes in the cluster.

2.1.3 Cloud Controller:

CLC issues run Instances, describe Instances, and terminate Instances and Describe Resources commands to a CC or a set of CCs. It manages all this information and being the only entry point to the cloud it schedules the VM instances. CLC also gives user visible interface to the cloud, for them to sign up and query the system; as well as cloud administrator interface for inspecting system component's availability.

2.1.3 Walrus

It is a data storage device which streams data in and out of the cloud, and also stores the VM images uploaded to Walrus and accessed from the nodes. It supports concurrent and serial data transfer. A part from these high-level components, an essential part of Eucalyptus is the Virtual Overlay Network which is VLAN implementation running over the top of Virtual Machines. Users attach a VM instance to a "Network" at the boot time. There is a unique VLAN tag for each such network which helps connect VMs to the public Internet and at the same time separate VMs belonging to different cloud allocations.

2.1.4 Associated Issues

Designed for the academic and research purposes, Eucalyptus deploys an infrastructure for VM creation controlled by the user. During the design the main issue was use of resources found within research environment. Hence the design of Eucalyptus uses hardware commonly found in existing laboratories, including Linux clusters and server farms. The networking used is simple and flat Virtual Networking which addresses three issues.

2.1.5 Connectivity

Virtual overlay network provides connectivity of nodes to public Internet and to other nodes running VM instances scheduled by the same cloud allocation. Connectivity can be partial too, so that at least one of the VM instance from a set of instances has connectivity to Internet, using which user can log in and access all the instances.

2.1.6 Isolation

The overlay network isolates of the network of the nodes of one cloud allocation from that of the nodes of some other cloud allocation for security issues. This prevents VM instance of one cloud allocation to acquire MAC address of physical resource and interfere with VM instances of other cloud allocations on the same resource.

2.1.7 Performance

Research is further facilitated by the modular nature of the design, helping researchers replace one component for enhancement without the need to interfere with others. Eucalyptus' simple design is such that it just offers the basic requirement of provisioning of services. It suffers from huge internal network traffic due to frequent access to data centers by the nodes. The cloud systems are configured having the peak traffic in to consideration. So most of the nodes and hence there sources are left idle most of the time.

Cloud Computing in Distributed in AOCAPI when CC gives a *remove Instance* command to the NC, it will neither remove the disk image from the machine nor disturb the file system. It will just mark it as disabled, treated same as removing the image. Hence, it can be again be marked as enabled and can run when the image has to be reloaded. This would eliminate the overhead in fetching the disk image from data center hence reducing network overheads. For this purpose of smart scheduling the address controller is used which decides to the address where each user request must be forwarded.

The address controller consults the usage register and recent index. The usage register monitors usage of all nodes by recording the information like CPU load on a node exerted by each virtual machine instance running on it. The recent index which records recent set of nodes used by each user. It stores the address of virtual machine instance to which a request was sent last time for a user, along with time stamp to find the most recent one.

3. CLOUD COMPUTING ARCHITECTURE

Cloud computing system, divide it into two sections:

1) ***Front end***
2) ***Back end***

They connect to each other through a network, usually the Internet. The front end is the side the computer user, or client, sees. The back end is the "cloud" section of the system.

3.1 Front end

The front end includes the client's computer (or computer network) and the application required to access the cloud computing system. Not all cloud computing systems have the same user interface. Services like Web-based e-mail programs leverage existing Web browsers like Internet Explorer or Firefox. Other systems have unique applications that provide network access to clients.

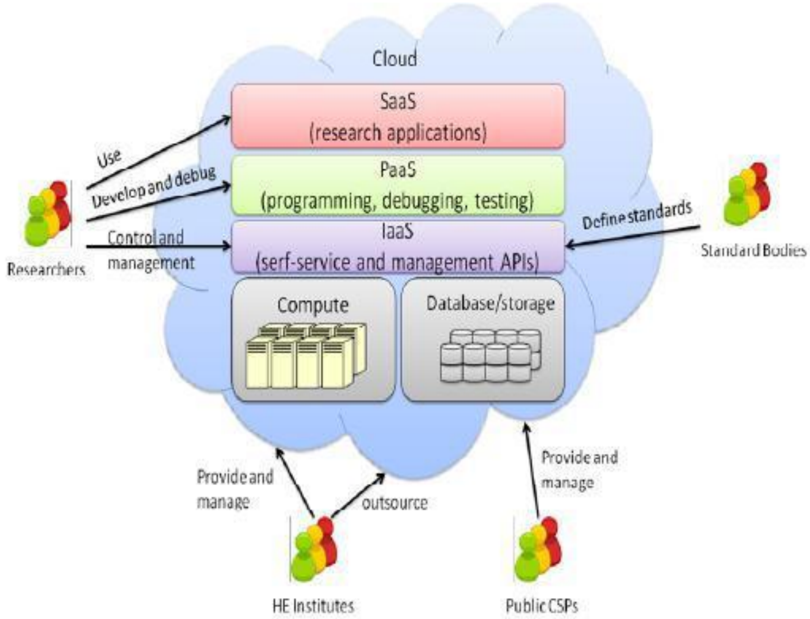

Figure 2 Front End of Cloud Architecture

3.1.1 Cloud Software as a Service (SaaS):

The consumers use the provider’s applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web-based email). The consumer does not manage or control the underlying cloud infrastructure

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including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

3.1.2 Cloud Platform as a Service (PaaS):

The consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages and tools supported by the provider. The consumer does not manage or control the cloud infrastructure, but has control over the deployed applications and possibly application hosting environment configurations.

3.1.3 Cloud Infrastructure as a Service (IaaS)

The consumer has the capability to provision processing, storage, networks, and other fundamental computing resources. The consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems; storage, deployed applications, and possibly limited control of select networking components (e.g., host firewalls)

3.2 BACK END

On the back end of the system are the various computers, servers and data storage systems that create the "cloud" of computing services. In theory, a cloud computing system could include practically any computer program you can imagine, from data processing to video games. Usually, each application will have its own dedicated server.

A central server administers the system, monitoring traffic and client demands to ensure everything runs smoothly. It follows a set of rules called **protocols** and uses a special kind of software called **middleware**. Middleware allows networked computers to communicate with each other. Most of the time, servers don't run at full capacity. That means there's unused processing power going to waste. It's possible to fool a physical server into thinking it's actually multiple servers, each running with its own independent operating system. The technique is called server virtualization. By maximizing the output of individual servers, server virtualization reduces the need for more physical machines.

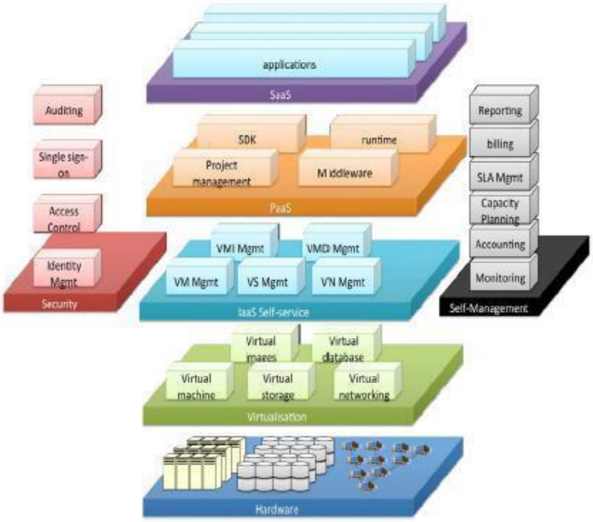

Figure 3 Back End of Cloud Architecture

4. CLOUD CHARACTERISTICS

Cloud computing exhibits the following key characteristics:

Empowerment, agility, application programming interface (API), cost, device and location independence, multi-tenancy: enables sharing of resources and costs across a large pool of users thus allowing for: centralization, peak-load capacity.

Characteristic	Definition
On-demand self-service	The cloud provider should have the ability to automatically provision computing capabilities, such as server and network storage, as needed without requiring human interaction with each service's provider.
Broad network access	According to NIST, the cloud network should be accessible anywhere, by almost any device (e.g., smart phone, laptop, mobile devices, PDA).
Resource pooling	The provider's computing resources are pooled to serve multiple customers using a multitenant model, with different physical and virtual resources dynamically assigned and reassigned according to demand. There is a sense of location independence. The customer generally has no control or knowledge over the exact location of the provided resources. However, he/she may be able to specify location at a higher level of abstraction (e.g., country, region or data center). Examples of resources include storage, processing, memory, network bandwidth and virtual machines
Rapid elasticity	Capabilities can be rapidly and elastically provisioned, in many cases automatically, to scale out quickly and rapidly released to scale in quickly. To the customer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.
Measured service	Cloud systems automatically control and optimize resource use by leveraging a metering capability (e.g., storage, processing, bandwidth and active user accounts). Resource usage can be monitored, controlled and reported, providing transparency for both the provider and customer of the utilized service.

Table 1 Cloud Characteristics

4.1 Understanding Public, Private and Hybrid Cloud

There are many considerations for cloud computing architects to make when moving from a standard enterprise application deployment model to one based on cloud computing. There are public and private clouds that offer complementary benefits, there are three basic service models to consider, and there is the value of open APIs versus proprietary ones

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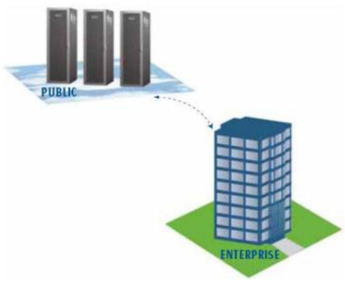
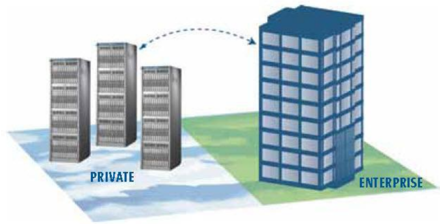
Public cloud



Private Cloud



Hybrid cloud

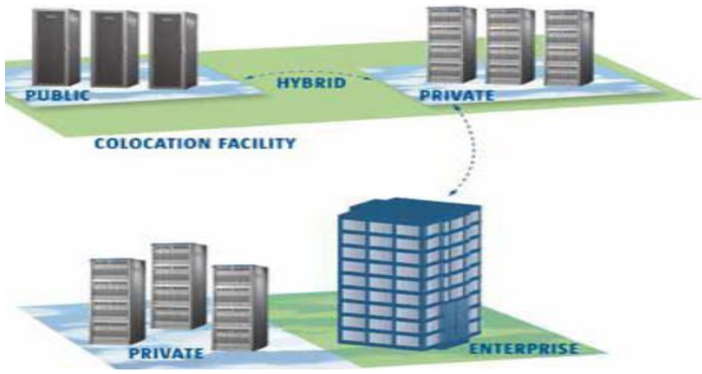


Figure 4 Public, Private and Hybrid Clouds

5. CLOUD COMPUTING DEPLOYMENT MODELS

Deployment Model	***Description of Cloud Infrastructure***	***To Be Considered***
Private cloud	• Operated solely for an organization • May be managed by the organization or a third party • May exist on-premise or off-premise	• Cloud services with minimum risk • May not provide the scalability and agility of public cloud services
Public cloud	• Made available to the general public or a large industry group • Owned by an organization selling cloud services	• Same as private cloud, plus: • Data may be stored with the data of competitors. • Data may be stored in unknown locations and may not be easily retrievable
Hybrid cloud	A composition of two or more clouds (private or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds)	• Aggregate risk of merging different deployment models • Classification and labelling of data will be beneficial to the security manager to ensure that data are assigned to the correct cloud type.

6. ADVANTAGES OF CLOUD COMPUTING

Cloud Computing is a form of Utility Computing with the following advantages:

- ***User- Centric***

Cloud services are simple to use. Users are not required to change their work environments. It is similar to accessing a traditional public utility such as water, electricity or gas.

- ***On-Demand Provisioning***

Cloud provides resources, infrastructure and services according to users' demands.

- ***Autonomous System***

In contrast to the distributed systems, the computing system is managed transparently to users. Hardware, software, and data in the cloud are configured to present a single platform image.

- **Scalability and flexibility**

These are the most important features of Distributed as well as Cloud Computing. The services and platforms are flexible and can be scaled to meet user requirements.

- ***Cost Reduction***

For small and medium-sized enterprises, the ability to outsource IT services and applications offer the potential to reduce overall costs. It also enables them to try processing-intensive activities by eliminating the need for up-front capital investment and reduces maintenance cost on dedicated infrastructure. By using applications from the cloud, the users save on software license fees and maintenance and update costs.

7. BASIC CHALLENGES IN CLOUD COMPUTING

Four issues stand out with cloud computing: threshold policy, interoperability issues, hidden costs, and unexpected behavior.

- ***Threshold Policy***

  To test of the program works, develop, or improve and implement, a threshold policy in a pilot study before moving the program to the production environment. Check how the policy detects sudden increases in the demand and results in the creation of additional instances to fill in the demand. Also check to determine how unused resources are to be de-allocated and turned over to other work.

- ***Interoperability issues***

The problems of achieving interoperability of applications between two cloud computing vendors. Need to reformat data or change the logic in applications.

- ***Hidden costs***

Cloud computing does not tell what hidden costs are. In an instance of incurring network costs, companies who are far from the location of cloud providers could experience latency, particularly when there is heavy traffic.

- ***Unexpected behavior***

The tests to be made to show unexpected results of validation or releasing unused resources. Need to fix the problem before running the application in the cloud. Also other issues are Cloud providers must work together to ensure that the challenges to cloud adoption are addressed through open collaboration and the appropriate use of standards. Cloud providers must not use their market position to lock customers into their particular platforms and limiting their choice of providers .Cloud providers must use and adopt existing standards wherever appropriate. The IT industry has invested heavily in existing standards and standards organizations; there is no need to duplicate or reinvent them. When new standards (or adjustments to existing standards) are needed, we must be judicious and pragmatic to avoid creating too many standards. We must ensure that Standards promote innovation and do not inhibit it. Any community effort around the open cloud should be driven by customer needs, not merely the technical needs of cloud providers, and should be tested or verified against real customer requirements**.**

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9. CONCLUSION

Cloud Computing is a new term for a long-held dream of computing as a utility. What originally started as Grid Computing, temporarily using remote supercomputers or clusters of mainframes to address large and complex scientific problems that could not be solved on in-house infrastructures, has evolved into a service-oriented business model that offers physical and virtual resources on a pay as you go basis? While Cloud Computing takes Distributed Computing to a utility stage, ubiquitous and unmetered access to broadband Internet is the key to its success. In addition, better standardization, portability and interoperability of its distributed components will help move Cloud Computing to its full potential.

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