Research Paper

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Cloud Computing : Overview, Challenges and Comparison with Grid Computing

Computer Science

KEYWORDS : Cloud Computing, Characteristics, Applications, Architecture, Service models, Deployment models and challenges of cloud computing, cloud computing VS Grid Computing

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ABSTRACT

Cloud Computing provides us a means by which we can access the applications as utilities, over the Internet. It allows us to create, configure, and customize applications online. Resource sharing in a pure plug and play model that dramatically simplifies infrastructure planning is the promise of „cloud computing". The two key advantages of this model are ease-of-use and cost-effectiveness. This paper describes overview of cloud computing, defines clouds, types of cloud providers, Deployment models, Characteristics applications, Architecture and challenges.

Introduction:

The term Cloud refers to a Network or Internet. In other words, we can say that Cloud is something, which is present at remote location. Cloud can provide services over network, i.e., on public networks or on private networks, i.e., WAN, LAN or VPN. Applications such as e-mail, web conferencing, customer relationship management (CRM), all run in cloud.

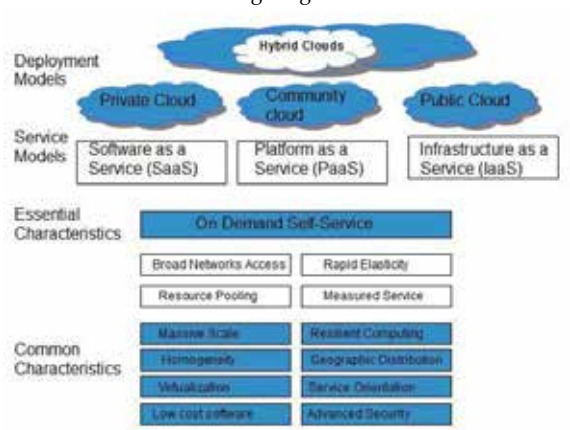
Cloud computing:

Cloud Computing refers to manipulating, configuring, and accessing the applications online. It offers online data storage, infrastructure and application.



Characteristics

There are four key characteristics of cloud computing. They are shown in the following diagram:



ON DEMAND SELF-SERVICE

Cloud Computing allows the users to use web services and resources on demand. One can logon to a website at any time and use them.

BROAD NETWORK ACCESS

Since Cloud Computing is completely web based, it can be accessed from anywhere and at any time.

RESOURCE POOLING

Cloud Computing allows multiple tenants to share a pool of resources. One can share single physical instance of hardware, database and basic infrastructure.

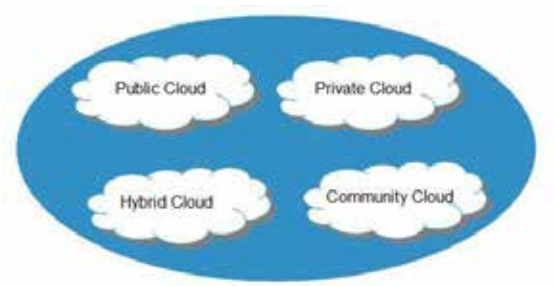
RAPID ELASTICITY

It is very easy to scale up or down the resources at any time. Resources used by the customers or currently assigned to customers are automatically monitored and resources.

There are certain services and models working behind the scene making the cloud computing feasible and accessible to end users. Following are the working models for cloud computing:

Deployment Models

Service Models



PUBLIC CLOUD

The Public Cloud allows systems and services to be easily accessible to the general public. Public cloud may be less secure because of its openness, e.g., e-mail.

PRIVATE CLOUD

The Private Cloud allows systems and services to be accessible within an organization. It offers increased security because of its private nature.

COMMUNITY CLOUD

The Community Cloud allows systems and services to be accessible by group of organizations.

HYBRID CLOUD

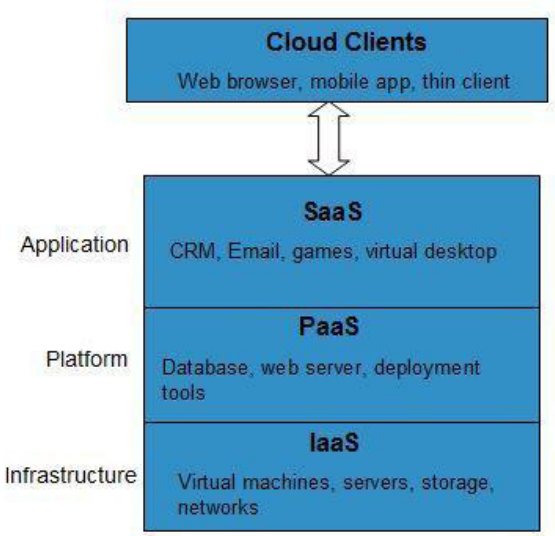
The Hybrid Cloud is mixture of public and private cloud. However, the critical activities are performed using private cloud while the non-critical activities are performed using

public cloud.

SERVICE MODELS
Service Models are the reference models on which the Cloud Computing is based. These can be categorized into three basic service models as listed below:

1. Infrastructure as a Service (IaaS)
2. Platform as a Service (PaaS)
3. Software as a Service (SaaS)

There are many other service models all of which can take the form like SaaS, i.e., anything as a Service. This can be Network as a Service, Business as a Service, Identity as a Service, Database as a Service or Strategy as a Service. The Infrastructure as a Service (IAAS) is the most basic level of service. Each of the service models make use of the underlying service model, i.e., each inherits the security and management mechanism from the underlying model, as shown in the following diagram:



INFRASTRUCTURE AS A SERVICE (IAAS)
IAAS provides access to fundamental resources such as physical machines, virtual machines, virtual storage, etc.

PLATFORM AS A SERVICE (PAAS)
PAAS provides the runtime environment for applications, development & deployment tools, etc.

SOFTWARE AS A SERVICE (SAAS)
SAAS model allows to use software applications as a service to end users.

Technologies:
There are certain technologies that are working behind the cloud computing platforms making cloud computing flexible, reliable, and usable. These technologies are listed below:

- Virtualization
- Service-Oriented Architecture (SOA)
- Grid Computing
- Utility Computing

Virtualization
Virtualization is a technique, which allows to share single physical instance of an application or resource among multiple organizations or tenants (customers). It does so by assigning a logical name to a physical resource and providing a pointer to that physical resource when demanded.

The Multitenant architecture offers virtual isolation among the multiple tenants and therefore the organizations can use and customize the application as though they each have its own instance running.

Service-Oriented Architecture (SOA)
Service-Oriented Architecture helps to use applications as a service for other applications regardless the type of vendor, product or technology. Therefore, it is possible to exchange of data between applications of different vendors without additional programming or making changes to services.

Grid Computing
Grid Computing refers to distributed computing in which a group of computers from multiple locations are connected with each other to achieve common objective. These computer resources are heterogeneous and geographically dispersed. Grid Computing breaks complex task into smaller pieces. These smaller pieces are distributed to CPUs that reside within the grid.

Utility Computing
Utility computing is based on Pay per Use model. It offers computational resources on demand as a metered service. Cloud computing, grid computing, and managed IT services are based on the concept of utility computing.

Cloud computing Challenges
1. Data Protection
Data Security is a crucial element that warrants scrutiny. Enterprises are reluctant to buy an assurance of business data security from vendors. They fear losing data to competition and the data confidentiality of consumers. In many instances, the actual storage location is not disclosed, adding onto the security concerns of enterprises. In the existing models, firewalls across data centers (owned by enterprises) protect this sensitive information. In the cloud model, Service providers are responsible for maintaining data security and enterprises would have to rely on them.

2. Data Recovery and Availability
All business applications have Service level agreements that are stringently followed. Operational teams play a key role in management of service level agreements and runtime governance of applications. In production environments, operational teams support

- Appropriate clustering and Fail over
- Data Replication
- System monitoring (Transactions monitoring, logs monitoring and others)
- Maintenance (Runtime Governance)
- Disaster recovery
- Capacity and performance management

If, any of the above mentioned services is under-served by a cloud provider, the damage & impact could be severe.

3. Management Capabilities
Despite there being multiple cloud providers, the management of platform and infrastructure is still in its infancy. Features like „Auto-scaling◎ for example, are a crucial requirement for many enterprises. There is huge potential to improve on the scalability and load balancing features provided today.

4. Regulatory and Compliance Restrictions
In some of the European countries, Government regula-

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tions do not allow customer's personal information and other sensitive information to be physically located outside the state or country. In order to meet such requirements, cloud providers need to setup a data center or a storage site exclusively within the country to comply with regulations. Having such an infrastructure may not always be feasible and is a big challenge for cloud providers.

Cloud computing VS Grid Computing

Parameter	Grid computing	Cloud computing
Goal	Collaborative sharing of resources	Use of service (eliminates the detail)
	Computationally intensive	Standard and high-level instances
	Operations	
Workflow management	In one physical node	In EC2 instance (Amazon EC2+S3)
Level of abstraction	Low (more details)	High (eliminate details)
Degree of scalability	Normal	High
Multitask	Yes	Yes
Transparency	Low	High
Time to run	Not real-time	Real-time services
Requests type	Few but large allocation	Lots of small allocation
Allocation unit	Job or task (small)	All shapes and sizes (wide &
		narrow)
Virtualization	Not a commodity	Vital
Portal accessible	Via a DNS system	Only using IP (no DNS registered)
Transmission	Suffered from internet delays	Was significantly fast
Security	Low (grid certificate service)	High (Virtualization)
Infrastructure	Low level command	High level services (SaaS)
Operating System	Any standard OS	A hypervisor (VM) on which
		multiple OSs run
Ownership	Multiple	Single
	Mostly internet with latency and low	Dedicated, high-end with low
	Bandwidth	latency and high bandwidth
Discovery	Centralized indexing and	Membership services
	decentralized info services	
Service negotiation	SLA based	SLA based
User management	Decentralized and also Virtual	Centralized or can be delegated to
	Organization (VO)-based	third party
Resource management	Distributed	Centralized/ Distributed
Allocation/ Scheduling	Decentralized	Both centralized/ decentralized
	Open grid forum standards	Web Services (SOAP and REST)
Failure management	Limited (often failed	Strong (VMs can be easily migrated
	tasks/applications are restarted)	from one node to other)

Conclusion:

Server computers are still needed to distribute the pieces of data and collect the results from participating clients on grid. Cloud offers more services than grid computing. In fact almost all the services on the Internet can be obtained from cloud, e.g. web hosting, multiple Operating systems, DB support and much more. Grids tends to be more loosely coupled, heterogeneous, and geographically dispersed compared to conventional cluster computing systems. There are several other security challenges including security aspect of network and virtualization. As the development of cloud computing technology is still at an early stage, we hope our work will provide a better understanding of the design challenges of cloud computing, and pave the way for further research in this area.

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