

1.Challenges and characteristics of cloud computing

Challenges:

Challenges faced by cloud computing: -

- Ability to use a variable number of physical machines and VM instances depending on the needs of a problem. That is the usage should be based on the requirement.
- The time required for instantiating new VMs – slow operation because each VM creates its own image from scratch.
- VM images needs to be stored and there is a lot of repeated content among them.
- Full virtualization at the hardware level also has the disadvantages of slow performance and low density.
- Sometimes hardware modification is needed to reduce the performance overhead of hardware-level virtualization.

Characteristics:

1. On-demand self-services:

The Cloud computing services does not require any human administrators, user themselves are able to provision, monitor and manage computing resources as needed.

2. Broad network access:

The Computing services are generally provided over standard networks and heterogeneous devices.

3. Rapid elasticity:

The Computing services should have IT resources that are able to scale out and in quickly and on as needed basis. Whenever the user require services it is provided to him and it is scale out as soon as its requirement gets over.

4. Resource pooling:

The IT resource (e.g., networks, servers, storage, applications, and services) present are shared across multiple applications and occupant in

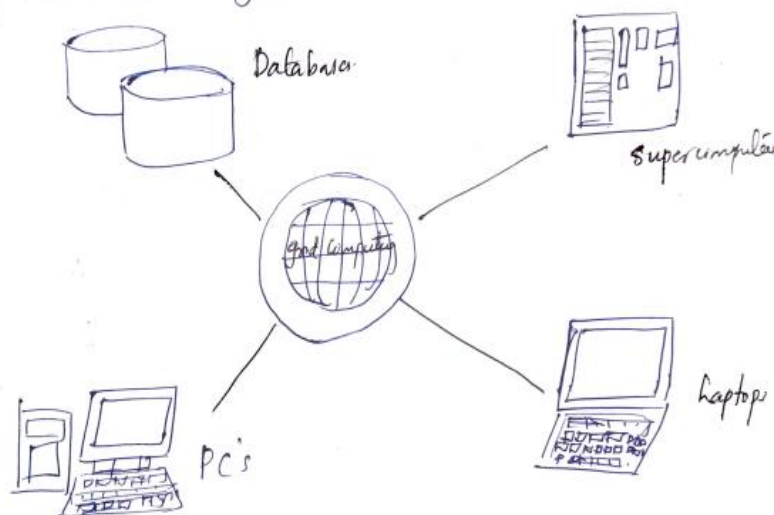
an uncommitted manner. Multiple clients are provided service from a same physical resource.

5. Measured service:

The resource utilization is tracked for each application and occupant, it will provide both the user and the resource provider with an account of what has been used. This is done for various reasons like monitoring billing and effective use of resource.

2. Grid Computing

Grid Computing refers to distributed computing in which a group 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 CPU's that reside within the grid.



- consistent
- inexpensive access to high computational capabilities

non-interactive workload.

PS
in Machine.

3. Virtualization and its types

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.

Types of virtualization

1. Application Virtualization.
2. Network Virtualization.
3. Desktop Virtualization.
4. Storage Virtualization.
5. Server Virtualization.
6. Data virtualization.

4. Cloud Services

Generally speaking, there are three basic types of cloud services:

- **Software as a Service (SaaS)**
The most widely recognized type of cloud service is known as [software as a service, or SaaS](#). This broad category encompasses a variety of services, such as file storage and backup, web-based email, and project management tools.
Examples of SaaS cloud service providers include Dropbox, G Suite, Microsoft Office 365, Slack and Citrix ShareFile. In each of these applications, users can access, share, store, and secure information in “the cloud.”
- **Infrastructure as a Service (IaaS)**
Infrastructure as a service, or IaaS, provides the infrastructure that many cloud service providers need to manage SaaS tools—but don’t want to

maintain themselves. It serves as the complete datacenter framework, eliminating the need for resource-intensive, on-site installations. Examples of IaaS are Amazon Web Services (AWS), Microsoft Azure and Google Compute Engine. These providers maintain all storage servers and networking hardware, and may also offer [load balancing](#), application firewalls, and more. Many well-known SaaS providers run on IaaS platforms.

- **Platform as a Service (PaaS)**

The cloud service model known as platform as a service, or PaaS, serves as a web-based environment where developers can build cloud apps. PaaS provides a database, operating system and programming language that organizations can use to develop cloud-based software, without having to maintain the underlying elements.

5.NIST Reference model

NIST Cloud Computing reference architecture defines five major performers:

Cloud Provider

Cloud Carrier

Cloud Broker

Cloud Auditor

Cloud Consumer

Each performer is an object (a person or an organization) that contributes to a transaction or method and/or performs tasks in Cloud computing. There are five major actors defined in the NIST cloud computing reference architecture, which are described below:

1. Cloud Service Providers: A group or object that delivers cloud services to cloud consumers or end-users. It offers various components of cloud computing. Cloud computing consumers purchase a growing variety of cloud services from cloud service providers. There are various categories of cloud-based services mentioned below:

IaaS Providers: In this model, the cloud service providers offer infrastructure components that would exist in an on-premises data center. These components consist of servers, networking, and storage as well as the virtualization layer.

SaaS Providers: In Software as a Service (SaaS), vendors provide a wide sequence of business technologies, such as Human resources management (HRM) software, customer relationship management (CRM) software, all of which the SaaS vendor hosts and provides services through the internet.

PaaS Providers: In Platform as a Service (PaaS), vendors offer cloud infrastructure and services that can access to perform many functions. In PaaS, services and products are mostly utilized in software development. PaaS providers offer more services than IaaS providers. PaaS providers provide operating system and middleware along with application stack, to the underlying infrastructure.

2. Cloud Carrier: The mediator who provides offers connectivity and transport of cloud services within cloud service providers and cloud consumers. It allows access to the services of the cloud through Internet networks, telecommunication, and other access devices. Network and telecom carriers or a transport agent can provide distribution. A consistent level of services is provided when cloud providers set up Service Level Agreements (SLA) with a cloud carrier. In general, Carrier may be required to offer dedicated and encrypted connections.

3. Cloud Broker: An organization or a unit that manages the performance, use, and delivery of cloud services by enhancing specific capability and offers value-added services to cloud consumers. It combines and integrates various services into one or more new services. They provide service arbitrage which allows flexibility and opportunistic choices. There are major three services offered by a cloud broker:

Service Intermediation.

Service Aggregation.

Service Arbitrage.

4. Cloud Auditor: An entity that can conduct independent assessment of cloud services, security, performance, and information system operations of the cloud implementations. The services that are provided by Cloud Service Providers (CSP) can be evaluated by service auditors in terms of privacy impact, security control, and performance, etc. Cloud Auditor can make an assessment of the security controls in the information system to determine the extent to which the controls are implemented correctly, operating as planned and constructing the desired outcome with respect to meeting the security necessities for the system. There are three major roles of Cloud Auditor which are mentioned below:

Security Audit.

Privacy Impact Audit.

Performance Audit.

5. Cloud Consumer: A cloud consumer is the end-user who browses or utilizes the services provided by Cloud Service Providers (CSP), sets up service contracts with the cloud provider. The cloud consumer pays peruse of the service provisioned. Measured services utilized by the consumer. In this, a set of organizations having mutual regulatory constraints performs a security and risk assessment for each use case of Cloud migrations and deployments.

Cloud consumers use Service-Level Agreement (SLAs) to specify the technical performance requirements to be fulfilled by a cloud provider. SLAs can cover terms concerning the quality of service, security, and remedies for performance failures. A cloud provider may also list in the SLAs a set of limitations or boundaries, and obligations that cloud consumers must accept. In a mature market environment, a cloud consumer can freely pick a cloud provider with better pricing and more favourable terms. Typically, a cloud provider's public pricing policy and SLAs are non-negotiable,

although a cloud consumer who assumes to have substantial usage might be able to negotiate for better contracts.

6. VMM

3 Hypervisor or VMM (Virtual Machine Monitor)

A hypervisor is a h/w virtualization technique allowing multiple OS called guests to run on a host machine. This is called the VMM.

* Type 1: bare metal hypervisor.

- sits on the bare metal h/w like CPU, m/b, etc.

• All guest OS are a layer above the hypervisor

- The original CP/CMS (Control Pgm / Cambridge monitor s/m) hypervisor developed by IBM of this kind.

* Type 2: hosted hypervisor

- Run over host OS.

• Hypervisor is the second layer over the H/w

- Guest OS run a layer over the hypervisor.

• The OS is usually unaware of virtualization

7. Open Source Cloud Platform

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