

## Experiment – 1

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SUBJECT NAME AND CODE: Cloud Computing CSL605

implement different types of virtualization techniques.	
Learning Objective:	To make students familiar with key concepts of virtualization.
Learning Outcome:	Students will be able To understand the origin of cloud computing, cloud cube model, NIST model, characteristics of cloud.
Course Outcome:	<b>CSL605.2</b>
Program Outcome:	<b>3.Design/development of solutions:</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
Bloom's Taxonomy Level:	Analysis
Theory:	1.cloud cube model, NIST model 2.characteristics of cloud 3.Different deployment models, service models, 4.Advantages and Disadvantages.
Outcome :	<p>There are several types of virtualization techniques, including:</p> <ol style="list-style-type: none"><li><b>1. Hardware virtualization:</b> This technique involves creating a virtual machine (VM) that runs on top of a physical host machine. The VM is isolated from the host machine and can run its own operating system and applications. Examples include VMware, Hyper-V, and Virtual Box.</li><li><b>2. Container virtualization:</b> This technique involves creating containers that share the host machine's operating system kernel. Containers are lightweight and portable, and they can be used to deploy applications quickly. Examples include Docker and Kubernetes.</li><li><b>3. Application virtualization:</b> This technique involves running an application in a virtual environment, separate from the host operating system. This allows the application to run on any operating system, regardless of compatibility issues. Examples include Microsoft App-V and VMware ThinApp.</li><li><b>4. Cloud virtualization:</b> This technique is used to create virtual resources, such as virtual machines, storage, and networks, on a cloud infrastructure. Cloud</li></ol>

providers like AWS, GCP, and Azure offer virtualization services.

5. **Network virtualization:** This technique is used to create virtual networks that run on top of a physical network. This allows for the creation of multiple isolated networks on a single physical infrastructure. Examples include VXLAN and NVGRE.

### Cloud Cube Model:

The cloud cube model is a way of categorizing different types of cloud computing services based on the level of control and customization provided to the user. The model consists of six different layers, or "cubes," that represent different levels of control and customization:

1. **Infrastructure as a Service (IaaS):** This is the lowest level of the cloud cube model. It provides users with access to raw computing resources, such as virtual machines, storage, and networking, which they can use to build and run their own applications.
2. **Platform as a Service (PaaS):** This layer sits on top of IaaS and provides users with a platform for building, deploying, and managing applications. It includes services such as databases, middleware, and development tools.
3. **Software as a Service (SaaS):** This layer sits on top of PaaS and provides users with access to ready-made applications, such as email, CRM, and ERP systems. These applications are typically accessed through a web browser.
4. **Business Process as a Service (BPaaS):** This layer provides access to specific business processes, such as HR, finance and accounting, and customer service. It is built on top of SaaS and offers a more specific set of tools and services to support a business process.
5. **Data as a Service (DaaS):** This layer provides access to data, such as big data analytics, data visualization, and data warehousing. It is built on top of BPaaS and SaaS and offers a more specific set of data management and analysis tools.
6. **Function as a Service (FaaS):** This is the highest level of the cloud cube model. It enables developers to run their code in the cloud without having to provision or manage servers. This is commonly known as serverless computing.

This model helps users understand the different types of cloud computing services available and the level of control and customization they provide. It also helps organizations choose the right type of cloud service for their specific needs.

### NIST model:

The National Institute of Standards and Technology (NIST) has developed a cloud computing reference model, which is commonly known as the NIST cloud computing model. It provides a standardized framework for understanding and describing cloud computing services and deployments. The NIST model consists of five essential characteristics, three service models, and four deployment models:

1. Essential Characteristics:
  - a. On-demand self-service: Users can provision computing resources as needed, without requiring human interaction with the service provider.
  - b. Broad network access: Resources are available over the network and

can be accessed from a variety of devices.

c. Resource pooling: The provider's computing resources are pooled to serve multiple customers, with the provider allocating and managing the resources dynamically.

2. Rapid elasticity: The capability to quickly provision and release resources as needed.

3. Measured service: The provider automatically controls and optimizes resource usage based on a metering capability.

### 3. Service Models:

a. Infrastructure as a Service (IaaS): Provides virtualized computing resources over the internet.

b. Platform as a Service (PaaS): Provides a platform for users to develop, run, and manage their own applications.

c. Software as a Service (SaaS): Provides access to software applications over the internet.

### 4. Deployment Models:

a. Private cloud: The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third-party provider.

b. Community cloud: The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns.

c. Public cloud: The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.

d. Hybrid cloud: The cloud infrastructure is a combination of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability.

e. The NIST cloud computing model provides a comprehensive and consistent way of defining and describing cloud computing services, making it easier for organizations to evaluate and compare different cloud solutions.

### **Characteristics of cloud:**

The characteristics of cloud computing, as defined by the National Institute of Standards and Technology (NIST), are as follow:

1. On-demand self-service: Users can provision computing resources as needed, without requiring human interaction with the service provider.
2. Broad network access: Resources are available over the network and can be accessed from a variety of devices, such as laptops, smartphones, and tablets.
3. Resource pooling: The provider's computing resources are pooled to serve multiple customers, with the provider allocating and managing the resources dynamically.
4. Rapid elasticity: The capability to quickly provision and release resources as needed, allowing the infrastructure to scale up or down based on the user's needs.
5. Measured service: The provider automatically controls and optimizes resource usage based on a metering capability, allowing users to pay only for the resources they use.
6. Scalability: Cloud computing services can easily scale up or down as required, providing businesses with the flexibility to respond to changes in demand.
7. High availability: Cloud providers use multiple servers and data centers to ensure that services are always available and accessible.
8. Cost-effective: Cloud computing allows organizations to pay only for the resources they use, which can be more cost-effective than maintaining their own IT infrastructure.
9. Security: Cloud providers use various security measures to protect data, such as encryption and multi-factor authentication.
10. Mobility: Cloud computing enables employees to access their data and applications from anywhere, on any device, increasing flexibility and productivity.

**Advantages of cloud:**

1. **Cost-effective:** Cloud computing allows organizations to pay only for the resources they use, which can be more cost-effective than maintaining their own IT infrastructure.
2. **Scalability:** Cloud computing services can easily scale up or down as required, providing businesses with the flexibility to respond to changes in demand.
3. **High availability:** Cloud providers use multiple servers and data centers to ensure that services are always available and accessible.
4. **Accessibility:** Cloud computing enables employees to access their data and applications from anywhere, on any device, increasing flexibility and productivity.
5. **Security:** Cloud providers use various security measures to protect data, such as encryption and multi-factor authentication.
6. **Automated software updates:** Cloud providers often handle software updates and maintenance, reducing the burden on IT departments.
7. **Backup and disaster recovery:** Cloud providers often offer built-in backup and disaster recovery solutions, reducing the need for businesses to invest in their own.
8. **Collaboration:** Cloud-based tools and services make it easy for remote teams to collaborate and share files.

**Disadvantages of cloud:**

1. **Dependence on internet connectivity:** Cloud computing requires a stable internet connection to function properly, which can be a problem for organizations in remote or rural areas.
2. **Security concerns:** Storing data and applications on remote servers can raise security concerns, such as data breaches and unauthorized access.
3. **Limited control over data:** Organizations may have limited control over their data when it's stored on a third-party server.
4. **Limited customization:** Organizations may have limited ability to customize their cloud-based solutions, which can make it difficult to meet specific business needs.
5. **Limited portability:** Some cloud-based solutions may be proprietary and therefore locked into a particular vendor, making it difficult to move data or applications to another provider.
6. **Compliance and regulatory issues:** Organizations may be required to comply with certain regulations or standards, and cloud-based solutions may not meet these requirements.
7. **Service downtime:** Cloud providers may experience service downtime due to maintenance, updates, or other issues, causing disruptions to the business.

Conclusion :	Thus, we learn and understood the different types of virtualization tools in cloud.
References:	<p>Give References:</p> <p>1.<a href="https://www.nist.gov/system/files/documents/itl/cloud/NIST_SP-500-291_Version-2_2013_June18_FINAL.pdf">https://www.nist.gov/system/files/documents/itl/cloud/NIST_SP-500-291_Version-2_2013_June18_FINAL.pdf</a></p>