Virtualization and Cloud Computing

Virtualization and types of Virtualization in Cloud Computing

Virtualization allows to share a single physical instance of a resource or an application among multiple customers and organizations at one time.

BENEFITS OF VIRTUALIZATION

1. More flexible and efficient allocation of resources.
2. Enhance development productivity.
3. It lowers the cost of IT infrastructure.
4. Remote access and rapid scalability.
5. High availability and disaster recovery.
6. Pay peruse of the IT infrastructure on demand.
7. Enables running multiple operating systems.

Types of Virtualization:

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

1. Application Virtualization:

Application virtualization helps a user to have remote access of an application from a server. The server stores all personal information and other characteristics of the application but can still run on a local workstation through the internet.

2. Network Virtualization:

The ability to run multiple virtual networks with each has a separate control and data plan.Network virtualization provides a facility to create and provision virtual networks—logical switches, routers, firewalls, load balancer, Virtual Private Network (VPN), and workload security within days or even in weeks.

3. Desktop Virtualization:

Desktop virtualization allows the users' OS to be remotely stored on a server in the data centre. It allows the user to access their desktop virtually, from any location by a different machine. Users who want specific operating systems other than Windows Server will need to have a virtual desktop. Main benefits of desktop virtualization are user mobility, portability, easy management of software installation, updates, and patches.

4. Storage Virtualization:

Storage virtualization is an array of servers that are managed by a virtual storage system. The servers aren't aware of exactly where their data is stored, and instead function more like worker bees in a hive.

5. Server Virtualization:

This is a kind of virtualization in which masking of server resources takes place. Here, the central-server(physical server) is divided into multiple different virtual servers by changing the identity number, processors. So, each system can operate its own operating systems in isolate manner.

6. Data virtualization:
This is the kind of virtualization in which the data is collected from various sources and managed that at a single place without knowing more about the technical information like how data is collected, stored & formatted then arranged that data logically so that its virtual view can be accessed by its interested people and stakeholders, and users through the various cloud services remotely. Many big giant companies are providing their services like Oracle, IBM, At scale, Cdata, etc.

Differences between LAN and VLAN are as follows:

LAN	VLAN
LAN stands for Local Area Network.	VLAN stands for Virtual Local Area Network.
It works on a single broadcast domain.	It works on multiple broadcast domain.
The cost of Local Area Network is high.	The cost of a Virtual Local Area Network is less.
The latency of Local Area Network is high.	The latency of a Virtual Local Area Network is low.
The devices which are used in LAN are: Hubs, Routers and switch.	The devices which are used in VLAN are: Bridges and switch.
They use standard Ethernet protocols.	They used ISP and VTP standard protocols.
Connection ranges up to 2 miles.	Connection has a similar range.
In local area network, the Packet is advertised to each device.	In virtual local area network, packet is send to specific broadcast domain.
Local area network is less efficient than virtual local area network.	Virtual local area network is greater efficient than local area network.
No information is needed to use LAN.	User should know multiple commands to configure VLAN.

What is the advantages of VLAN?

1. **Performance –**
   The network traffic is full of broadcast and multicast. VLAN reduces the need to send such traffic to unnecessary destinations. e.g.-If the traffic is intended for 2 users but as 10 devices are present in the same broadcast domain, therefore, all will receive the traffic i.e. wastage of bandwidth but if we make VLANs, then the broadcast or multicast packet will go to the intended users only.
2. **Formation of virtual groups –**
   As there are different departments in every organization namely sales, finance etc., VLANs can be very useful in order to group the devices logically according to their departments.
3. **Security –**
   In the same network, sensitive data can be broadcast which can be accessed by the outsider but by creating VLAN, we can control broadcast domains, set up firewalls, restrict access. Also, VLANs can be used to inform the network manager of an intrusion. Hence, VLANs greatly enhance network security.
4. **Flexibility –**
   VLAN provide flexibility to add, remove the number of host we want.
5. **Cost reduction –**
   VLANs can be used to create broadcast domains which eliminate the need for expensive routers.
   By using Vlan, the number of small size broadcast domain can be increased which are easy to handle as compared to a bigger broadcast domain.

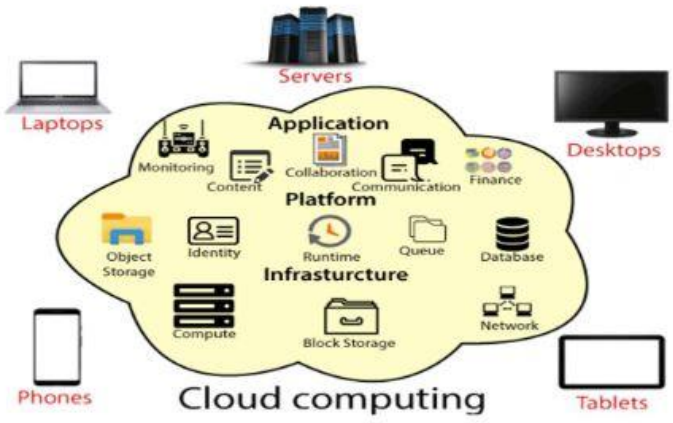
Disadvantages of VLAN

1. **Complexity:** VLANs can be complex to configure and manage, particularly in large or dynamic cloud computing environments.
2. **Limited scalability:** VLANs are limited by the number of available VLAN IDs, which can be a constraint in larger cloud computing environments.
3. **Limited security**: VLANs do not provide complete security and can be compromised by malicious actors who are able to gain access to the network.
4. **Limited interoperability**: VLANs may not be fully compatible with all types of network devices and protocols, which can limit their usefulness in cloud computing environments.
5. **Limited mobility**: VLANs may not support the movement of devices or users between different network segments, which can limit their usefulness in mobile or remote cloud computing environments.
6. **Cost:** Implementing and maintaining VLANs can be costly, especially if specialized hardware or software is required.
7. **Limited visibility:** VLANs can make it more difficult to monitor and troubleshoot network issues, as traffic is isolated in different segments.

UNIT-II

What is the cloud?
"The cloud" refers to servers that are accessed over the Internet, and the software and databases that run on those servers. Cloud servers are in data centres all over the world. By using cloud computing, users and companies do not have to manage physical servers themselves or run software applications on their own machines.

Definition of Cloud Computing:
The term “Cloud Computing” refers to services provided by the cloud that is responsible for delivering of computing services such as servers, storage, databases, networking, software, analytics, intelligence, and more, over the Cloud (Internet). Cloud computing applies a virtualized platform with elastic resources on demand by provisioning hardware, software, and data sets dynamically



Advantages of cloud computing:

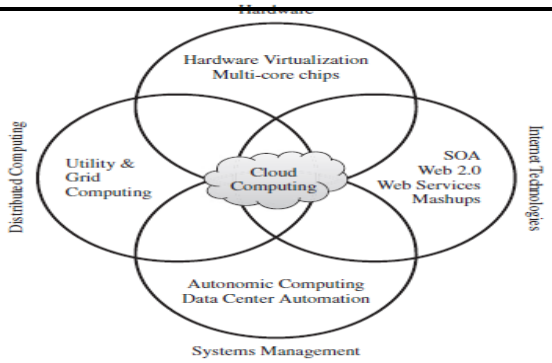
1. Cost: It reduces the huge capital costs of buying hardware and software.
2. Speed: Resources can be accessed in minutes, typically within a few clicks.
3. Scalability: We can increase or decrease the requirement of resources according to the business requirements.
4. Productivity: While using cloud computing, we put less operational effort. We do not need to apply patching, as well as no need to maintain hardware and software. So, in this way, the IT team can be more productive and focus on achieving business goals.

5. Reliability: Backup and recovery of data are less expensive and extremely fast for business continuity.
6. Security: Many cloud vendors offer a broad set of policies, technologies, and controls that strengthen our data security.

Cloud computing shares characteristics with:
1. **Client–server model**—Client–server computing refers broadly to any distributed application that distinguishes between service providers (servers) and service requestors (clients).
2**. Grid computing**—A form of distributed and parallel computing, whereby a 'super and virtual computer' is composed of a cluster of networked, loosely coupled computers acting in concert to perform very large tasks.
3. Fog computing—Distributed computing paradigm that provides data, compute,storage and application services closer to the client or near-user edge devices, such as network routers. Furthermore, fog computing handles data at the network level, on smart devices and on the end-user client-side (e.g., mobile devices), instead of sending data to a remote location for processing.
4. Mainframe computer—Powerful computers used mainly by large organizations for critical applications, typically bulk data processing such as census; industry and consumer statistics; police and secret intelligence services; enterprise resource planning; and financial transaction processing.
5. Utility computing—The packaging of computing resources, such as computation and storage, as a metered service similar to a traditional public utility, such as electricity.
6. Peer-to-peer—A distributed architecture without the need for central coordination. Participants are both suppliers and consumers of resources (in contrast to the traditional client-server model).
7. Green computing—Study and practice of environmentally sustainable computing or IT.
8. Cloud sandbox—A live, isolated computer environment in which a program, code or file can run without affecting the application in which it

Characteristics of Cloud Computing
1. Agility for organizations
2. Cost reductions, Centralization of infrastructure in locations with lower costs.
3. Device and location independence, which means no maintenance, required.
4. Pay-per-use means utilization and efficiency improvements for systems that are often only 10–20% utilized.
5. Performances are being monitored by IT experts i.e., from the service provider end.
6. Productivity increases which results in multiple users who can work on the same data simultaneously.
7. Time may be saved as information does not need to be re-entered when fields are matched
8. Availability improves with the use of multiple redundant sites
9. Scalability and elasticity via dynamic ("on-demand") provisioning of resources on a fine-grained, self-service basis in near real-time without users having to engineer for peak loads.
10. Self-service interface.
11. Resources thatare abstracted or virtualized.
12. Security can improve due to centralization of data

ROOTS OF CLOUD COMPUTING
We can track the roots of clouds computing by observing the advancement of several technologies, especially in hardware (virtualization, multi-core chips), Internet technologies (Web services, service-oriented architectures, Web 2.0), distributed computing (clusters, grids), and systems management (autonomic computing, data center automation).



significantly advanced and contributed to the advent of cloud computing. The emergence of cloud computing itself is closely linked to the maturity of such technologies. We present a closer look at the technologies that form the base of cloud computing, with the aim of providing a clearer picture of the cloud ecosystem.

1. From Mainframes to Clouds

We are currently experiencing a switch in the IT world, from in-house generated computing power into utility-supplied computing resources delivered over the Internet as Web services. This trend is like what occurred about a century ago when factories, which used to generate their own electric power, realized that it is was cheaper just plugging their machines into the newly formed electric power grid.Computing delivered as a utility can be defined as "on demand delivery of infrastructure, applications, and business processes in a security-rich, shared, scalable, and based computer environment over the Internet for a fee"

2. SOA, Web Services, Web 2.0, and Mashups

The emergence of Web services (WS) open standards has significantly con-tributed to advances in the domain of software integration. Web services can glue together applications running on different messaging product plat-forms, enabling information from one application to be made available to others, and enabling internal applications to be made available over the Internet.WS standards have been created on top of existing ubiquitous technologies such as HTTP and XML, thus providing a common mechanism for delivering services, making them ideal for implementing a service-oriented architecture (SOA). The purpose of a SOA is to address requirements of looselycoupled, standards-based, and protocol-independent distributed computing. In a SOA, software resources are packaged as "services," which are well-defined,self- contained modules that provide standard business functionality and are independent of the state or context of other services. Services are described in a standard definition language and have a published interface.

LAYERS AND TYPES OF CLOUDS

Cloud computing services are divided into three classes, according to the abstraction level of the capability provided and the service model of providers, namely:

1. Infrastructure as a Service,

2. Platform as a Service, and Software as a Service.

Infrastructure as a Service

A cloud infrastructure enables on-demand provisioning of servers running several choices of operating systems and a customized software stack. Infrastructure services are considered as the bottom layer of cloud computing systems. Offering virtualized resources (computation, storage, and communication) on demand is known as Infrastructure as a Service (IaaS). One of the best examples is Amazon Web Services mainly offers IaaS, which in the case of its EC2 service means offering VMs with a software stack that can be customized similar to how an ordinary physical server would be customized.

Service Class	Main Access & Management Tool	Service content
SaaS	Web Browser	**Cloud Applications** Social networks, Office suites, CRM, Video processing
PaaS	Cloud Development Environment	**Cloud Platform** Programming languages, Frameworks, Mashups editors, Structured data
IaaS	Virtual Infrastructure Manager	**Cloud Infrastructure** Compute Servers, Data Storage, Firewall, Load Balancer

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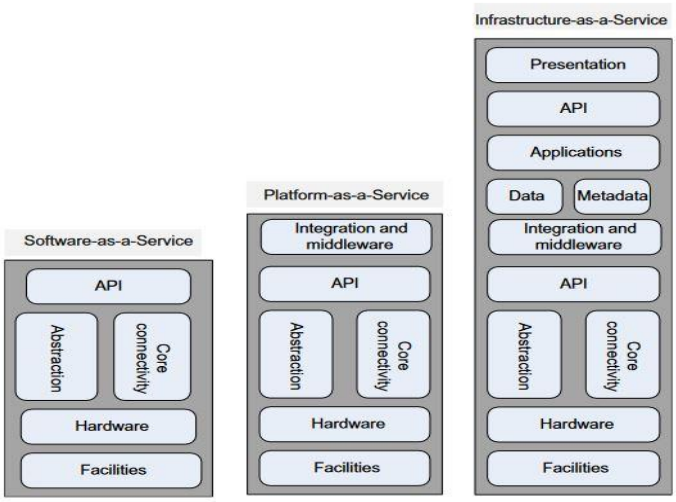
Platform as a Service

A cloud platform offers an environment on which developers create and deploy applications and do not necessarily need to know how many processors or how much memory that applications will be using. In addition, multiple program- ming models and specialized services (e.g., data access, authentication, and payments) are offered as building blocks to new applications. Google AppEngine, an example of Platform as a Service, offers a scalable environment for developing and hosting Web applications, which should be written in specific programming languages such as Python or Java, and use the services' own proprietary structured object data store. Software as a Service Traditional desktop applications such as word processing and spreadsheet can now be accessed as a service in the Web. This model of delivering applications, known as Software as a Service (SaaS), alleviates the burden of software maintenance for customers and simplifies development and testing for providers. Salesforce.com, which relies on the SaaS model, offers business productivity applications (CRM) that reside completely on their servers, allowing customers to customize and access applications on demand.



DESIRED FEATURES OF A CLOUD

Certain features of a cloud are essential to enable services that truly represent the cloud-computing model and satisfy expectations of consumers, and cloud offerings must be having following features:

1. Self-service
2. Per-usage metered and billed
3. Elastic,
4. Customizable.

The following are the features that are explained in detail.

1. Self-Service

Consumers of cloud computing services expect on-demand, nearly instant access to resources. To support this expectation, clouds must allow self-service access so that customers can request, customize, pay, and use services without intervention of human operators.

2. Per-Usage Metering and Billing

Cloud computing eliminates up-front commitment by users, allowing them to request and use only the necessary amount. Services must be priced on a short- term basis (e.g., by the hour), allowing users to release (and not pay for) resources as soon as they are not needed. For these reasons, clouds must implement features to allow efficient trading of service such as pricing, accounting, and billing. Metering should be done accordingly for different types of service (e.g., storage, processing, and bandwidth) and usage promptly reported, thus providing greater transparency.

3. Elasticity

Cloud computing gives the illusion of infinite computing resources available on demand. Therefore, users expect clouds to rapidly provide resources in any quantity at any time. In particular, it is expected that the additional resources can be (a) provisioned, possibly automatically, when an application load increases and (b) released when load decreases (scale up and down).

4. Customization

In a multi-tenant cloud a great disparity between user needs is often the case. Thus, resources rented from the cloud must be highly customizable. In the case of infrastructure services, customization means allowing users to deploy specialized virtual appliances and to be given privileged (root) access to the virtual servers. Other service classes (PaaS and SaaS) offer less flexibility and are not suitable for general-purpose computing, but still are expected to provide a certain level of customization.