Virtualization

Virtualization is technology that you can use to create virtual representations of servers, storage, networks, and other physical machines. Virtual software mimics the functions of physical hardware to run multiple virtual machines simultaneously on a single physical machine.

Virtualization is basically a creation of a virtual version of something, such as an operating system (OS), a server, a storage device or network resources. OS virtualization is the use of software to allow a piece of hardware to run multiple operating system images at the same time.

With virtualization, an application, a guest OS or data storage is separated from the underlying software or hardware. A thin software layer, known as a hypervisor, reproduces the functions and actions of the underlying hardware for the abstracted hardware or software, creating multiple virtual machines on a single physical system.

Types of Virtualization

1.**Server Virtualization**:

The Server Virtualization is the division of the physical server into multiple virtual servers for efficient utilization of server resources. Virtualization of the servers hides or masks server resources such as processor, operating system, memory, and presents users as a private virtual server.

Example — VMware vSphere suite by VMware, Hyper-V by Microsoft are some Hypervisors for server virtualization.

2. **Operating System Virtualization**:
Operating System virtualization is the type where the division of OS happens. That is the core of the Operating System which in other words referred to as the kernel resources get shared and allow isolated instances of namespaces to exist with dedicated resources to run different applications. These instances are called containers.

Example — Docker is the most widely used container engine.

3. **Memory Virtualization:**
Memory Virtualization introduces a way to decouple memory from the processor and from the server to provide a shared, distributed or networked function. This is not a more addressable memory but virtualized memory shared between multiple machines. It enhances performance by providing greater memory capacity without any addition to the main memory.

4. **CPU Virtualization:**
CPU Virtualization is one of the cloud-computing technology that requires a single CPU to work, which acts as multiple machines working together**.** This is like running two separate computers on a single physical machine. The most common reason for doing this is to run two different operating systems on one machine. The aim of CPU virtualization is to make a CPU run in the same way as if two separate CPUs would run.

5. File System Virtualization:
Virtual Disks: Virtualization platforms use virtual disks that are stored as files on the host's file system. These virtual disks can be managed independently and can be moved or copied between virtual machines.
6.Memory Virtualization:
Hypervisors often employ memory overcommitment, allowing VMs to use more virtual memory than physically available. The hypervisor uses techniques like page sharing, ballooning, and memory compression to manage memory efficiently.
7.Device Drivers Virtualization:
Virtual Device Drivers: Virtual machines use virtual device drivers that communicate with the hypervisor's virtualized devices.

Provisioning

Provisioning is the process of creating and setting up IT infrastructure, and includes the steps required to manage user and system access to various resources.

Underprovisioning:

Underprovisioning refers to the situation where the allocated computing resources are insufficient to meet the demands of an application, service, or workload.

Key Problems and Consequences:

Performance Degradation:
Insufficient resources lead to degraded performance, slower response times, and increased latency.

System Downtime:
Critical applications may experience downtime or become unresponsive during periods of high demand.

Inefficient Resource Utilization:
Low resource utilization rates result in inefficiencies, and organizations may pay for underutilized resources.

Increased Operational Costs:
Addressing performance issues often involves emergency scaling or manual interventions, leading to higher operational costs.

Scalability Challenges:
Underprovisioned systems may struggle to scale efficiently to handle increased workloads.

Example : **E-commerce Website During a Sale:**

- Use Case: An e-commerce website experiences a sudden surge in traffic during a major sale event.
- Underprovisioning Scenario: The infrastructure is not scaled to handle the increased load, resulting in slow page loads, transaction failures, and a poor user experience.

Overprovisioning:

Overprovisioning occurs when more computing resources are allocated than necessary to meet the demands of an application, service, or workload.

Key Problems and Consequences:

Excessive Costs:
Allocating more resources than needed leads to increased infrastructure costs.

Wasted Resources:
Resources may go unused, contributing to wasted capacity and inefficiency.

Environmental Impact:
Overprovisioning results in unnecessary energy consumption and an increased environmental impact.

Complexity in Resource Management:
Managing and maintaining an overprovisioned environment can be complex, leading to challenges in tracking and optimizing resources.

Limited Scalability:
Overprovisioned systems may struggle to scale efficiently due to limitations in available resources.

Example: **Yearly Peak Season for Retailers:**

- Use Case: Retailers experience significantly higher demand during holiday seasons.
- Overprovisioning Scenario: To ensure ample resources are available, retailers may overprovision throughout the year, leading to wasted resources during non-peak periods.