Content from different reference book suggested "Cloud Computing Black book [Kailash Jayaswal,Jagannath Kallakurchi, Donald J. Houde, Dr. Deven Shah & Kogent Learning Solutions Inc.]" by Prof. Sujata Mam and mentioned in CC Syllabus file, Presentations, Notes provided in 2023

NOTES ON BASIS OF CHP 2 virtualization to CC PPT

REFER PPT IN WHICH DIAGRAMS ARE THERE IMP CONTENT

NOTES

Virtualization Notes:

Definition:
- Virtualization is the abstraction of computer resources.
- It hides the physical characteristics of resources from how other systems, applications, or users interact with them.
- It can involve making a single physical resource appear as multiple logical resources or vice versa.

Virtualization Overview:
- A hardware-reducing, cost-saving, and energy-saving technology.
- Transforms IT landscape and changes computing methodologies.
- Increases efficiency, utilization, and flexibility of existing hardware.
- Allows running multiple OSes and applications on the same server concurrently.

Virtualization Layers:
- Virtual Machine Monitor (VMM) or Hypervisor: Middleware between hardware and virtual machines.
- Virtual Machine (VM): Represents isolated environments running OSes and applications.
- Guest Operating System: OS running inside a virtual machine.

Hypervisor:
- Allows multiple OSes to share a single hardware host.
- Controls host resources and allocates them to guest OSes.
- Ensures guest OSes cannot disrupt each other.

Types of Hypervisors:
1. Type 1 (Bare-Metal Hypervisor): Directly on hardware, guest OSes on top.
2. Type 2 (Hosted Hypervisor): Over host OS, guest OSes on top.

Virtualization Benefits:
- Maximizes resource sharing, reduces hardware costs.
- Minimizes maintenance needs.
- Utilizes OS services, isolates multiple systems.
- Tests beta software, maintains legacy applications.
- Enhances system security, enables disaster management.
- Provides encapsulation and portability.
- Offers hardware independence.

Virtualization Categories:
1. Platform Virtualization: Simulates virtual machines.
2. Resource Virtualization: Simulates combined or simplified resources.

Platform Virtualization Techniques:
- Emulation: Complete hardware simulation for different CPU architectures.
- Full Virtualization: Simulates enough hardware for unmodified guest OS to run.
- Paravirtualization: Offers special APIs for modifying guest OS.
- Operating System-Level Virtualization: Creates isolated containers on a single physical server.
- Library-Level Virtualization: Creates execution environments for running alien programs.
- Application-Level Virtualization: Virtualizes an application as a VM.

Full Virtualization vs. Paravirtualization:
- Full Virtualization: Emulates instructions via binary translation, no OS modification.
- Paravirtualization: Requires guest OS modification, uses hypercalls for non-virtualizable instructions.

Multi-Core Virtualization:
- Virtual Cores (VCPUs): Can exceed the number of physical cores.
- Easier resource management and design when hardware assists in dynamic resource utilization.
- Supports better resource management and helps with complex software scenarios.

These notes cover the concept of virtualization, its types, benefits, and various virtualization techniques, including full virtualization, paravirtualization, and different levels of virtualization. It also touches on multi-core virtualization and the advantages of hardware assistance in managing virtual cores.

Virtualization

Virtualization is a concept in computing that involves abstracting and managing computer resources, allowing them to be used more efficiently and flexibly. It encompasses the creation of virtual versions of physical resources like servers, operating systems, applications, and storage devices, enabling multiple instances to run independently while sharing the same physical hardware.

What is Virtualization

Virtualization is a technology that reduces hardware costs, saves energy, and transforms IT operations. It enables running multiple operating systems and applications on a single physical server, thus increasing hardware utilization and flexibility. Virtualization offers benefits like reduced IT costs, increased efficiency, utilization, and flexibility of existing hardware, and the ability to isolate and manage operating systems and applications as single units.

Virtual Machine, Guest Operating System, and VMM (Virtual Machine Monitor)

The virtualization layer, also known as the Virtual Machine Monitor (VMM) or hypervisor, acts as middleware between the underlying hardware and the virtual machines in the system. A hypervisor allows multiple operating systems (guests) to share the same hardware host, ensuring resource allocation and isolation between guests to prevent disruptions.

Difference between Traditional Computers and Virtual Machines

Before Virtualization:
- Single OS image per machine
- Tight coupling of software and hardware
- Running multiple applications on the same machine can cause conflicts
- Inflexible and costly infrastructure

After Virtualization:
- Hardware-independent OS and applications
- Virtual machines can be provisioned to any system
- OS and applications can be managed as a single unit through encapsulation
- Improved flexibility and reduced infrastructure costs

Virtualization Benefits

Virtualization offers various benefits, including:
- Maximizing resource sharing
- Reducing hardware costs
- Minimizing maintenance requirements
- Utilizing OS services efficiently
- Isolating multiple systems
- Testing beta software and maintaining legacy applications
- Enhancing system security
- Disaster management
- Encapsulation for portability and hardware independence

Virtualization Categories

Virtualization is divided into two main categories:
1. Platform Virtualization: Involves simulating virtual machines, creating a virtual environment for guest software to run.
2. Resource Virtualization: Simulates fragmented or simplified resources, optimizing resource utilization.

Platform Virtualization

Platform virtualization involves creating virtual machines using a combination of hardware and software. These virtual machines are managed by a host software, creating simulated computer environments for guest software. Different approaches to platform virtualization include:
- Emulation or simulation
- Native virtualization and full virtualization
- Partial virtualization
- Paravirtualization
- Operating system-level virtualization
- Application virtualization

Hypervisor

A hypervisor, also known as a Virtual Machine Monitor (VMM), manages multiple guest operating systems on a single hardware host. There are two types of hypervisors:
1. Type 1 (Bare Metal) Hypervisor: Operates directly on hardware, managing guest OSs on top of it.
2. Type 2 (Hosted) Hypervisor: Runs on a host operating system and manages guest OSs on top of the host.

Major VMM and Hypervisor Providers

Some major providers of virtualization solutions include Xen, VMware, and KVM. These solutions offer different approaches to virtualization, such as full virtualization, para-virtualization, and hardware-assisted virtualization.

Conclusion

Virtualization is a crucial technology that optimizes hardware utilization, reduces costs, and enhances flexibility in IT environments. It enables the creation of virtual instances of various resources and offers different levels of virtualization, from instruction set architecture level to application level, each with its advantages and limitations. Hypervisors play a key role in managing and orchestrating virtual machines, enabling efficient sharing of physical hardware resources among multiple guest operating systems.