

IS 651: Distributed Systems

Chapter 13: Cloud Computing

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Spring 2021

Learning Outcomes

- After learning this chapter, you should be able to
 - Understand the basics of Cloud Computing, its service models and deployments
 - Understand the four types of Server Virtualization and their differences

Cloud Computing

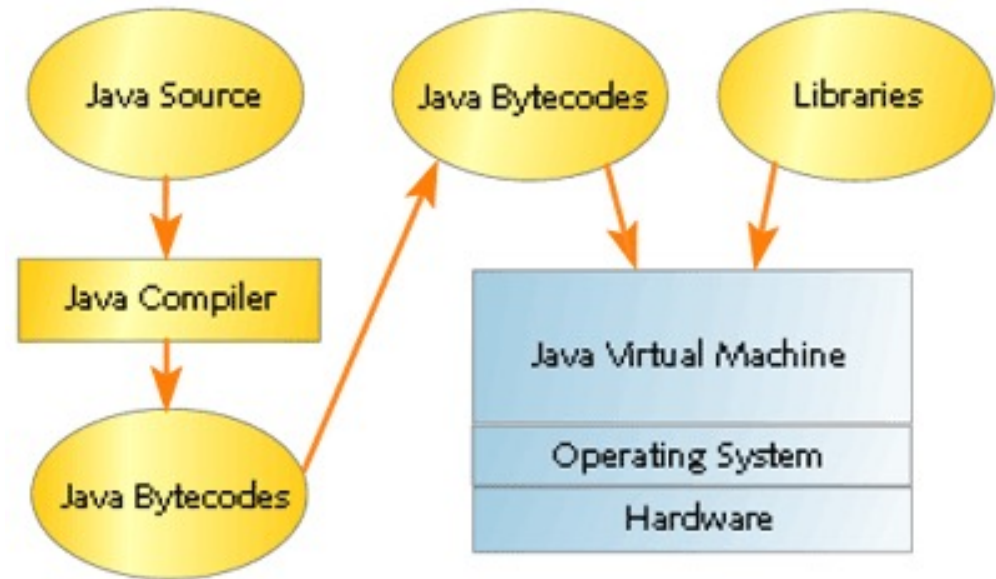
- It is defined as delivering shared, metered services on the Internet
- It is built on hardware virtualization and service-oriented architecture
- Benefits:
 - A high speed of deployment according to the service model
 - Much less cost in most cases, since there is no capital investment and the use of resources is metered by the provider (like your water bill)
 - Providers are expected to keep up with fast changing technologies
 - Elastic/scalability, variable capacity is inherent in the infrastructure from service providers so if one needs small capacity most of the time, but a lot at holiday season, one only pays for what is used

Server Virtualization

- Application-level Virtual Machine
- Operating System-level Virtual Machine
- Full-virtualization Virtual Machine
- Para-virtualization Virtual Machine

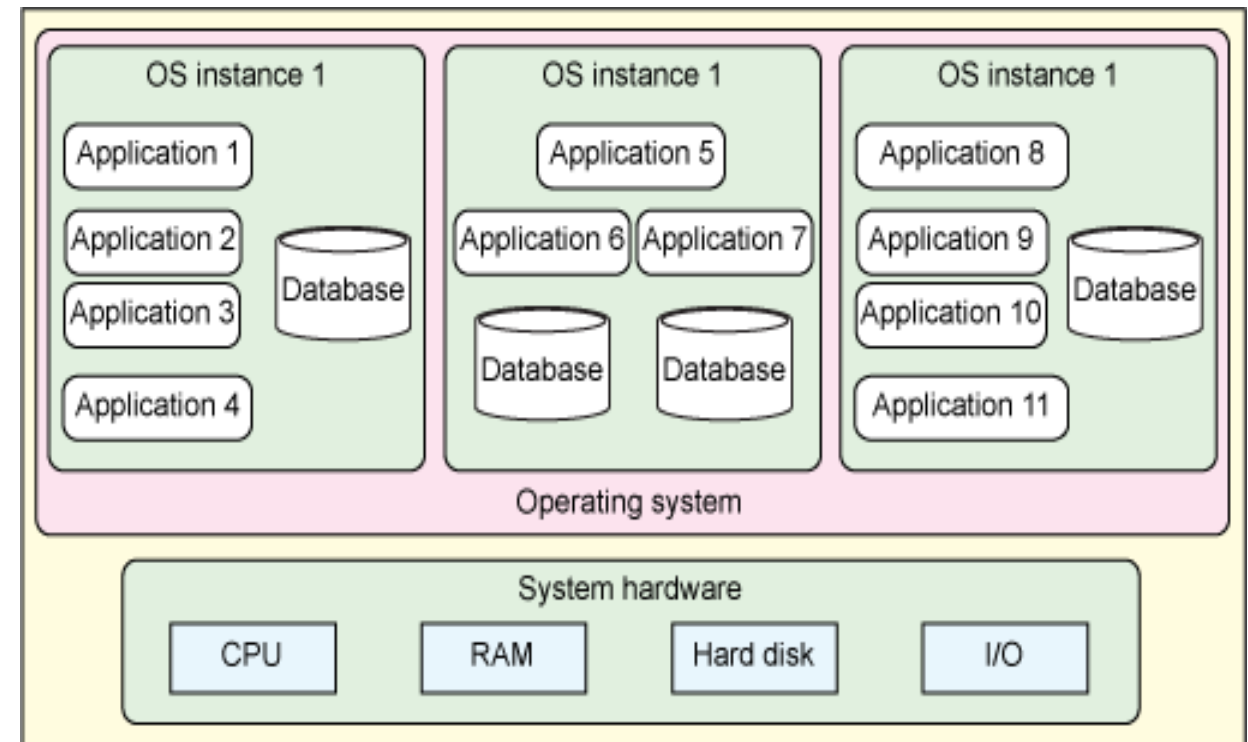
Application-level Virtual Machine

- It virtualizes the running computer program separately from the machine code that a typical compiler would produce
- The most common example of application virtualization is Java



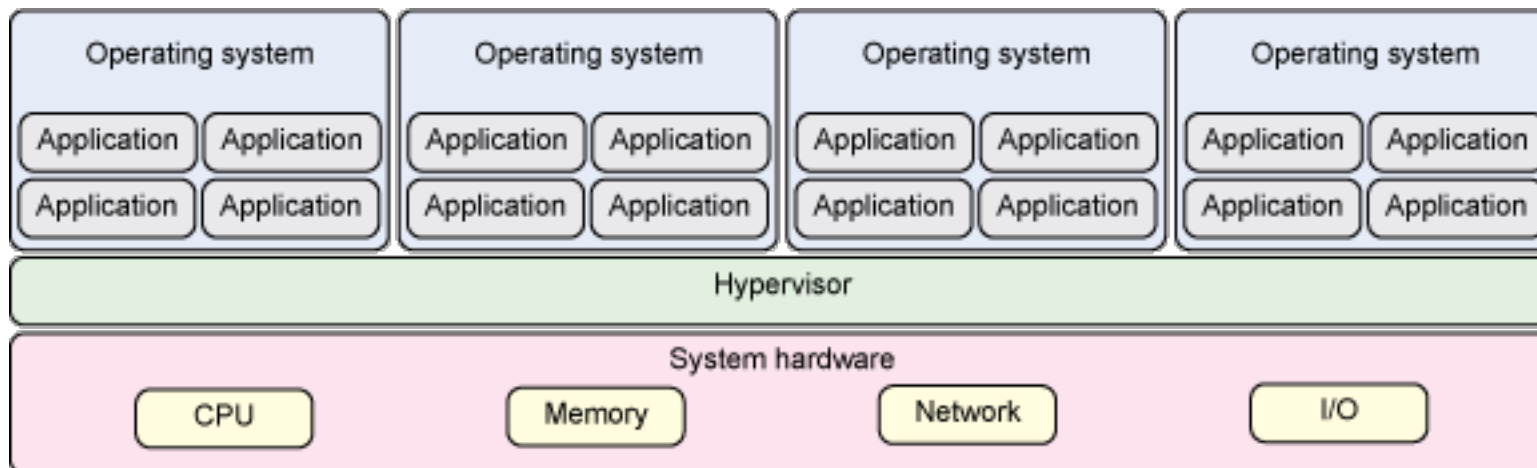
Operating System-level Virtual Machine

- It allows a host OS to run multiple, virtual guest OSs
- This is commonly used for desktop virtualization where the common motivation is to run another OS in order to run an application and not have to have another computer
- Common software: VirtualBox, VMware, etc.



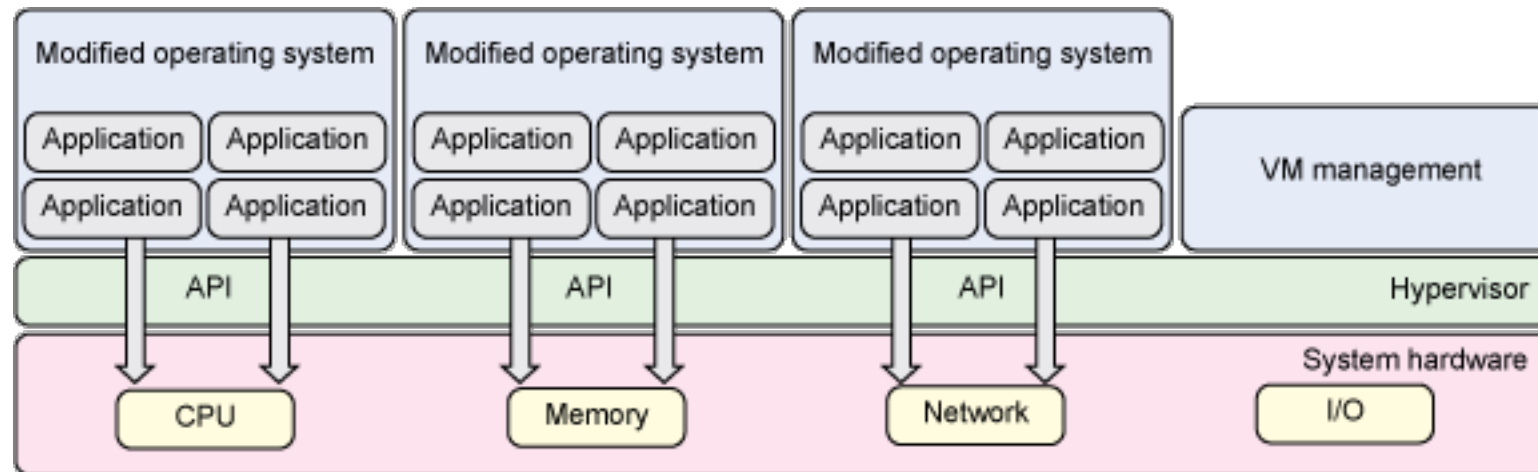
Full-virtualization Virtual Machine

- It is the first VM technology that would be used for servers
- It introduces the concept of a **hypervisor** which acts as an interface between the hardware and all guest OSs
- Users can login to virtual machines directly



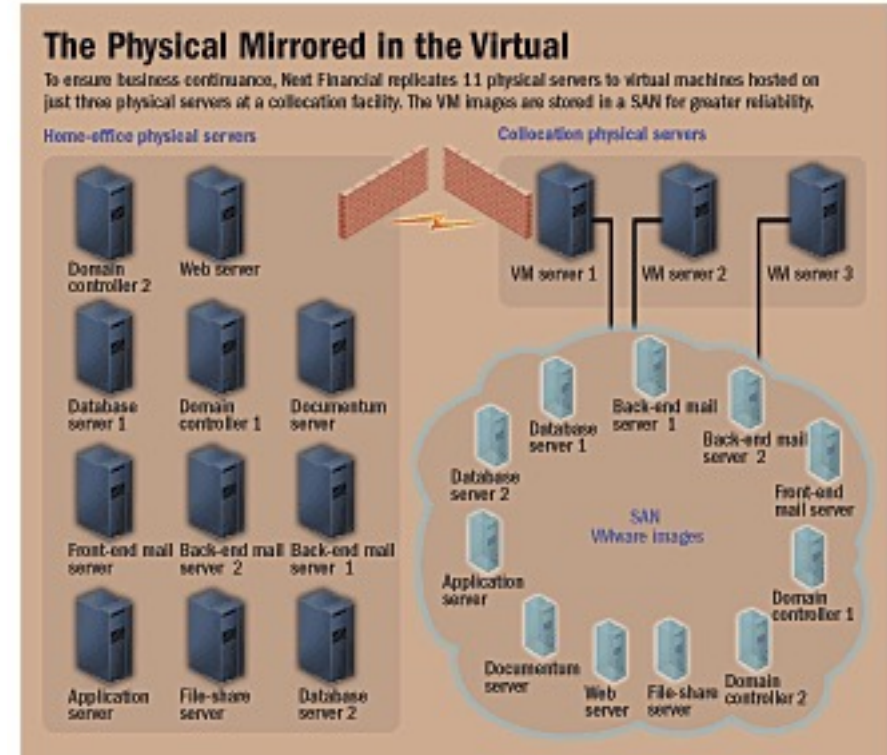
Para-virtualization Virtual Machine

- Para-virtualization is a version of full-virtualization that requires the guest OSs to be modified in minor ways to run more efficiently on the hypervisor
 - The modification is hardly noticeable by users
- This can lead to performance increases

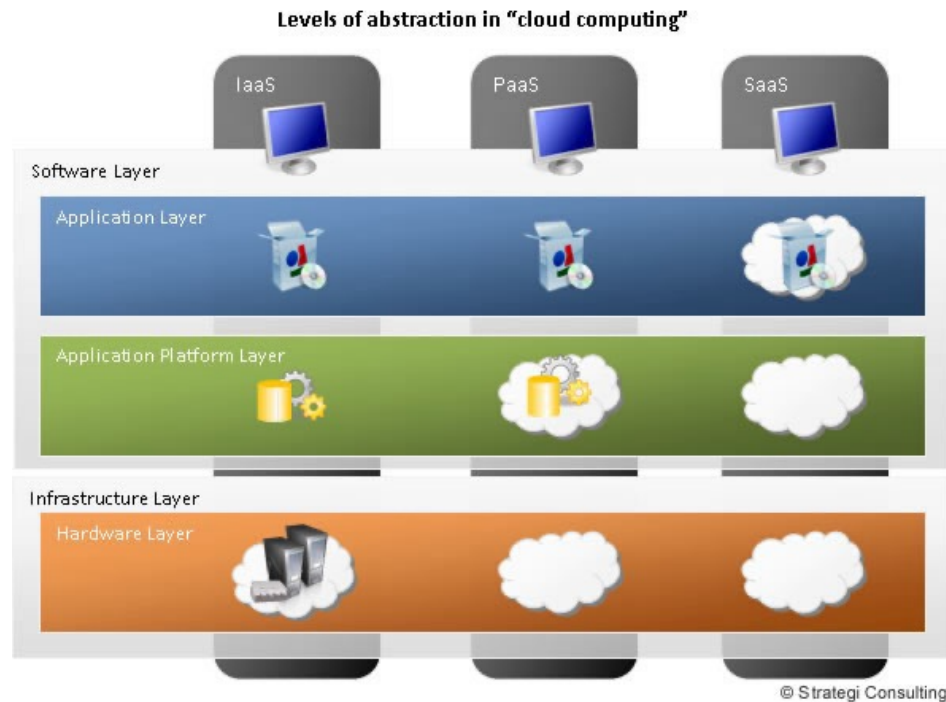


Virtualization for Server Consolidation

- The figure shows how to consolidate from 11 physical machines to 3 physical machines and a virtual environment
- You could have multiple virtual machines on one physical machine and one virtual machine on multiple physical machines



Cloud Computing Service Models



Software as a service (SaaS)



Platform as a service (PaaS)



Infrastructure as a service (IaaS)



Cloud Computing Deployment

- Public clouds: Amazon Web Service, Microsoft Azure, etc.
- Private clouds: setting up a cloud environment locally using software like Openstack
- Hybrid clouds: some resource from public clouds + some resource from private clouds

Challenges with Cloud Computing

- Security
 - Popular cloud resources like Amazon Web Service and iCloud could be targeted
- Reliability
 - Unavailability of cloud resources could be disastrous for all applications hosted on them
- Budgetary costs for long-term usage could be higher than those for on premise resources