IS 651: Distributed Systems
Chapter 13: Cloud Computing

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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 Xmas, 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

Levels of abstraction in "cloud computing"

- Software Layer
  - Application Layer
  - Application Platform Layer
- Infrastructure Layer
  - Hardware Layer

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<th>Software as a service (SaaS)</th>
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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