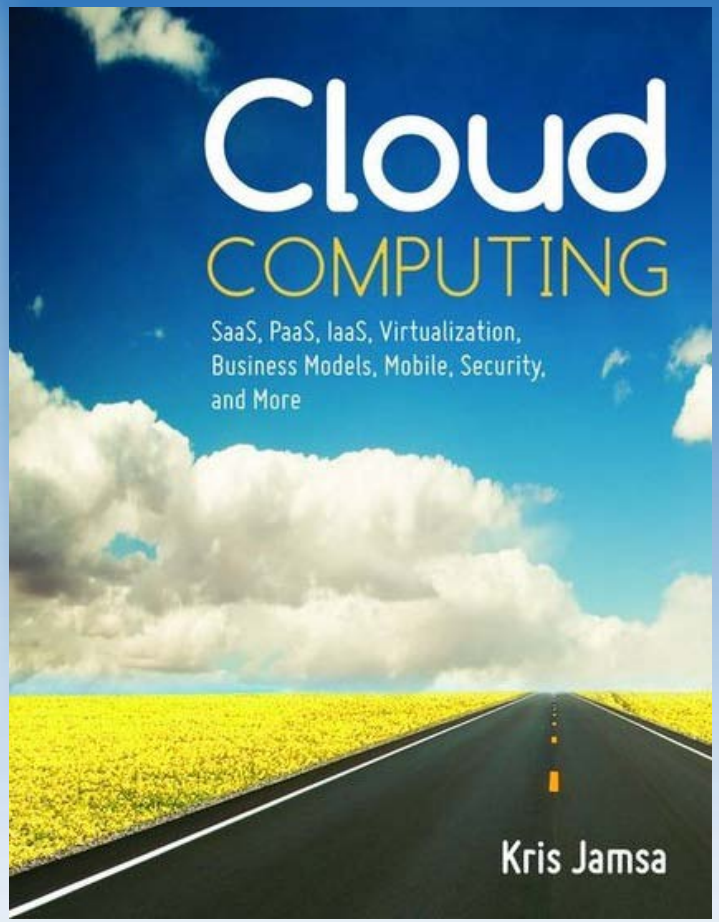



# Cloud Computing

## Chapter 1

## Introducing Cloud Computing

JONES & BARTLETT LEARNING
An Ascend Learning Company

# Learning Objectives

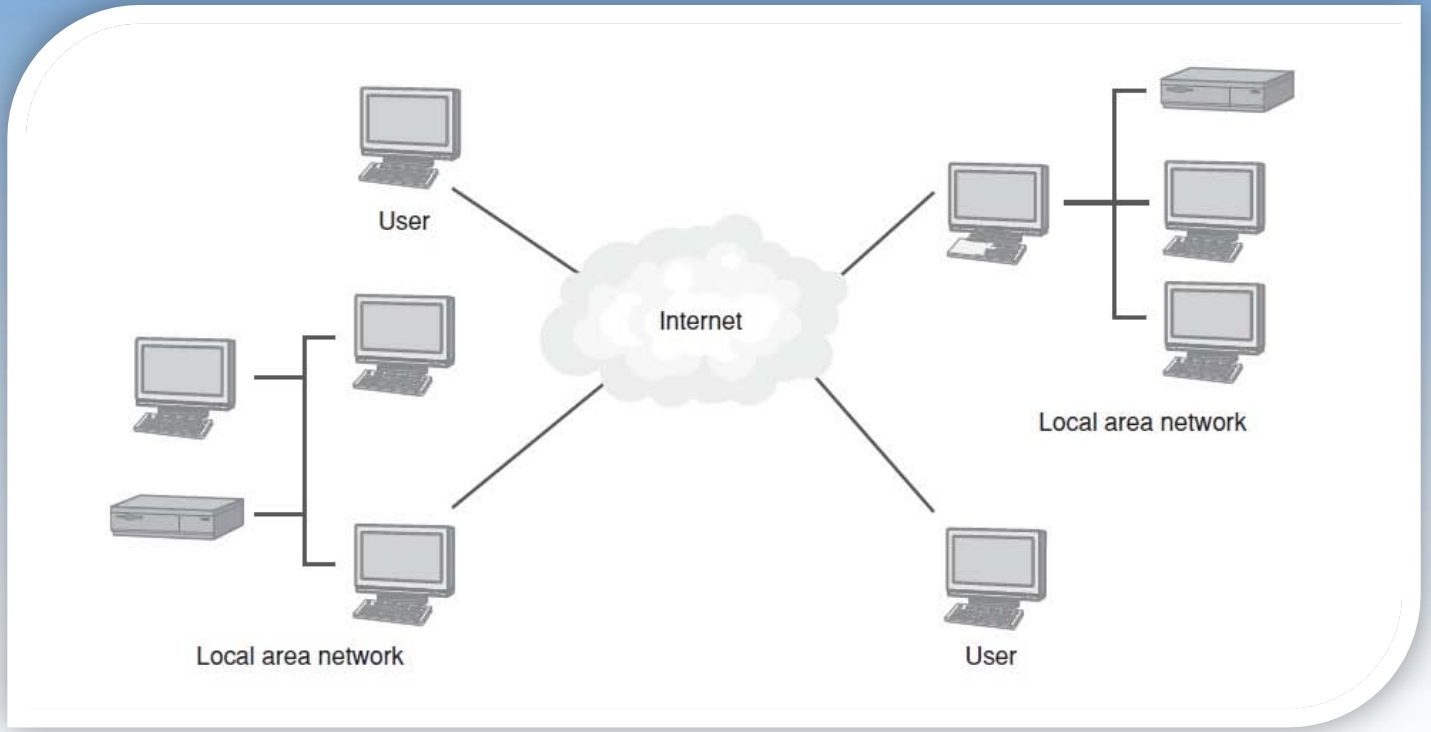
- Understand the abstract nature of cloud computing.
- Describe evolutionary factors of computing that led to the cloud.
- Describe virtualization at both the desktop and the server level.
- Describe and identify common cloud types, which include software as a service, platform as a service, and infrastructure as a service.
- Know how businesses and individuals use the cloud.
- Describe the benefits and disadvantages of cloud computing.
- Understand common security considerations with respect to the cloud.
- Describe ways cloud computing can improve system fault tolerance.
- Describe Web 2.0 and its relationship to cloud computing.

# Cloud Computing Defined

- **Cloud computing** describes the abstraction of web-based computers, resources, and services that system developers can utilize to implement complex web-based systems.

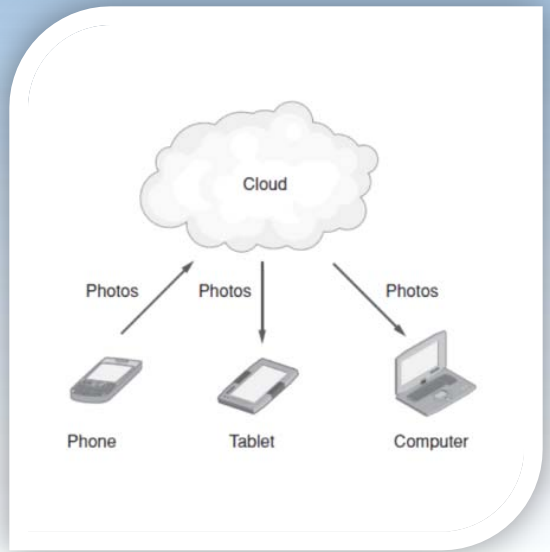
# Why Use the Term “Cloud”

- For years developers and network administrators have represented the Internet as a cloud.



# Real World: **Apple iCloud**

- Using iCloud, users can synchronize their content to a variety of devices.

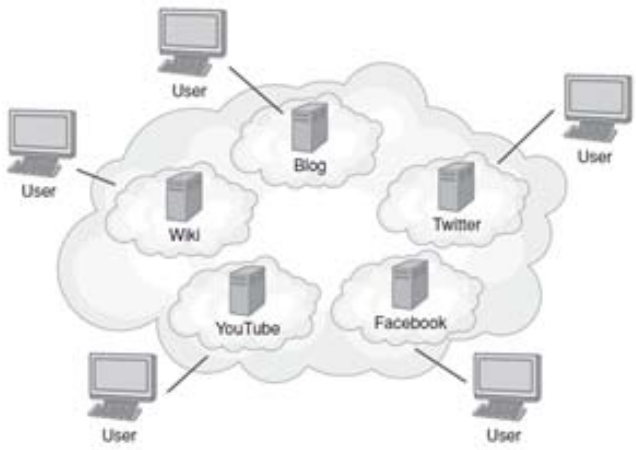



# Role of Web 2.0

- Web 2.0 tools and sites, users essentially publish content directly to the cloud for access by other users.

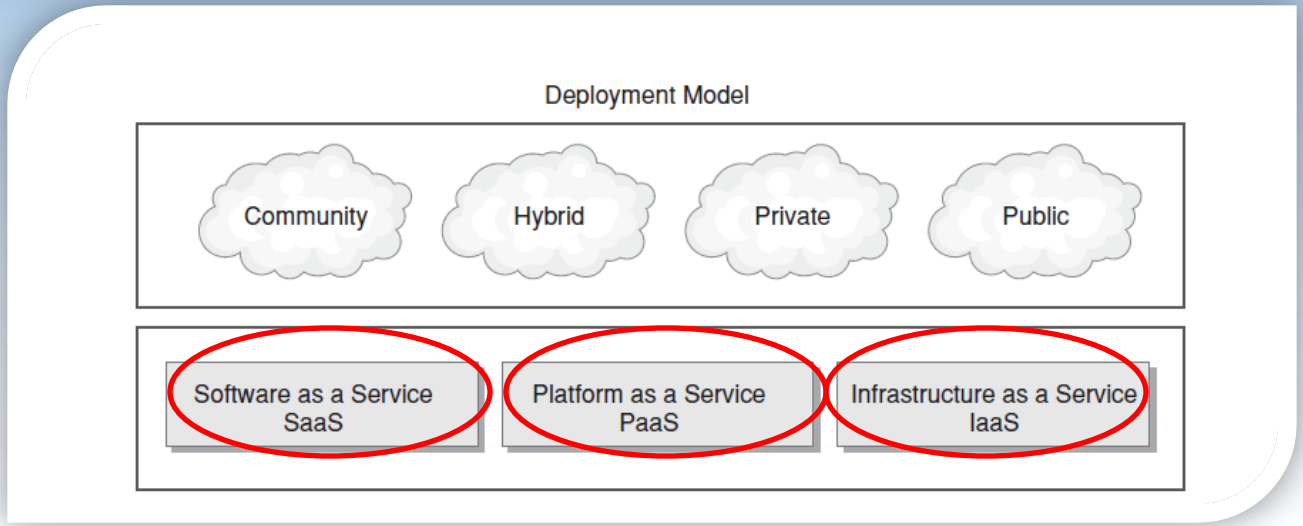
**TABLE 1-1 COMMON WEB 2.0 SITES AND APPLICATIONS**

| Application/Site | Purpose |
|---|---|
| Blog | A web log that users can write and use to publish content directly to the web. |
| Wiki | A software program that allows users to collaborate on shared web-based documents. |
| Twitter | A microblogging service that allows users to send messages of up to 140 characters to those who *follow* the users' *tweets*. |
| Facebook | A social networking site to which users can post text, photos, and video-based content. |
| YouTube | A site to which users can upload video content for sharing with others. |



# Understanding Cloud Types

- To analyze and describe cloud-based systems, people refer to a cloud solution in terms of its **deployment model** and **services model**.
- These two terms originated from the National Institute of Standards and Technology (NIST)



# Cloud Deployment Models

**TABLE 1-2 CLOUD DEPLOYMENT MODELS**

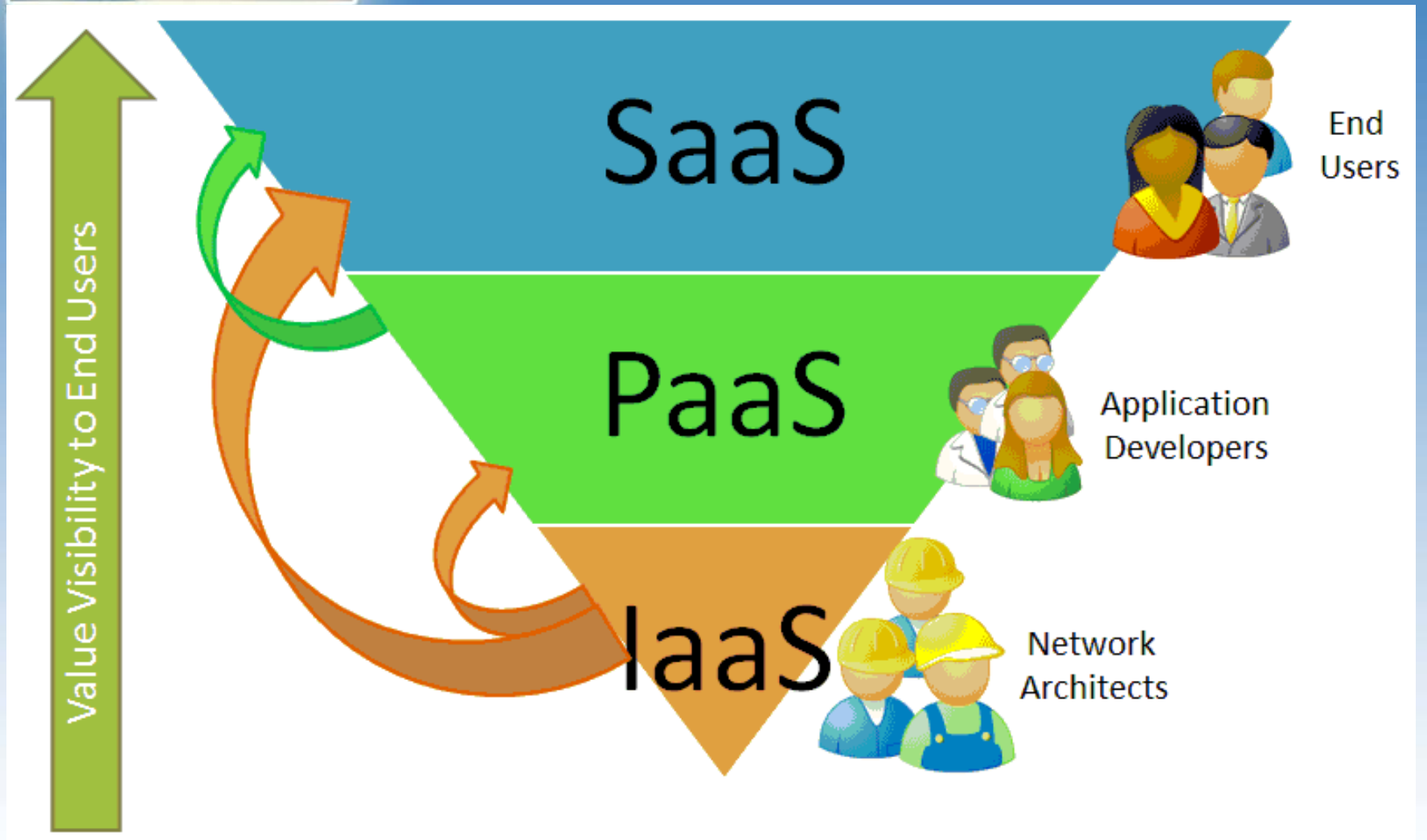
| Deployment Model | Characteristics |
|---|---|
| Private cloud | Owned by a specific entity and normally used only by that entity or one of its customers. The underlying technology may reside on- or off-site. A private cloud offers increased security at a greater cost. |
| Public cloud | Available for use by the general public. May be owned by a large organization or company offering cloud services. Because of its openness, the cloud may be less secure. A public cloud is usually the least expensive solution. |
| Community cloud | The cloud is shared by two or more organizations, typically with shared concerns (such as schools within a university). |
| Hybrid cloud | A cloud that considers two or more private, public, or community clouds. |

# Cloud Service Models

TABLE 1-3 COMMON CLOUD SERVICE MODELS

| Cloud Service Model | Characteristics |
|---|---|
| Software as a service (SaaS) | A complete software application with a user interface. |
| Platform as a service (PaaS) | A platform within which developers can deploy their applications. A PaaS solution includes hardware (servers and disks), operating systems, development tools, and administrative tools. |
| Infrastructure as a service (IaaS) | Provides machines, storage, and network resources that developers can manage by installing their own operating system, applications, and support resources. |

# Cloud Service Models



# Real World: Windows Azure

- **Windows Azure** is a Microsoft platform developers can use to move applications to the cloud.
- Windows Azure provides operating-system support for .NET applications and a cloud-based SQL server (SQL Azure).
- Windows Azure platform maintains servers, operating systems, database software, and other supporting applications.
- Windows Azure can scale to meet the developer's needs.

# Features of Cloud-Based Platforms

- **Scalability:** On demand resource scaling.
- **Redundancy:** Servers, storage, and networks.
- **Cost benefits from resource pooling:** Shares IT resources across a very large number of companies, which provides cost savings to each.
- **Outsourced server management:** Provides an IT staff who maintain operating systems and underlying support software.
- **Low cost of entry:** Companies do not need to invest in their own IT data center.

# Software as a Service (SaaS)

- SaaS provides a cloud-based foundation for **software** on demand.
- Web-delivered content that users access via a web browser.
- The software can reside within any of the deployment-model clouds.

# SaaS Advantages and Disadvantages

- Advantages:
  - simplicity of integration (users need only a browser), cost (the data center resides within the cloud), and scalability (customers can add user licenses or seats as needed).

- Disadvantage:
  - perception of **security** issues.

# Real World: Salesforce.com

- One of the first companies to launch a large-scale SaaS.
- Recognized that regardless of the items a company sold, the selling process was similar across companies and even industries.
- Automated these tasks and put the underlying data storage in the cloud—the sales cloud.

0080-114-8701

搜尋

客戶登入

免費試用

解決方案 | 產品 | 支援 | 合作夥伴 | 社群 | 客戶 | 公司

# Salesforce.com

## 無需軟體。無需硬體。無需煩惱。

利用雲端運算及 CRM 中深獲信賴的領導者進行企業轉型

註冊免費試用版 ›

觀看示範 ›

與我聯絡 ›

### Sales Cloud

利用全球第一的銷售及 CRM 應用程式大大提高您的銷售

詳細資料 | 觀看示範 | 方案與價格

### Service Cloud

提供擁有主要支援、服務及支援中心解決方案的絕佳服務

詳細資料 | 觀看示範 | 方案與價格

### Marketing Cloud

借助領先的社交營銷應用程序隨處都可吸引顧客

詳細資料

### Salesforce Force.com

在主要的雲端平台上建構並執行創新的應用程式及網站

詳細資料 | 觀看示範 | 方案與價格

### Salesforce Chatter

借助備受信賴的員工社交網絡參與會話

詳細資料 | 觀看示範 | 方案與價格

### Salesforce Work.com

使用社交HR績效管理應用程序進行更好的協作

詳細資料

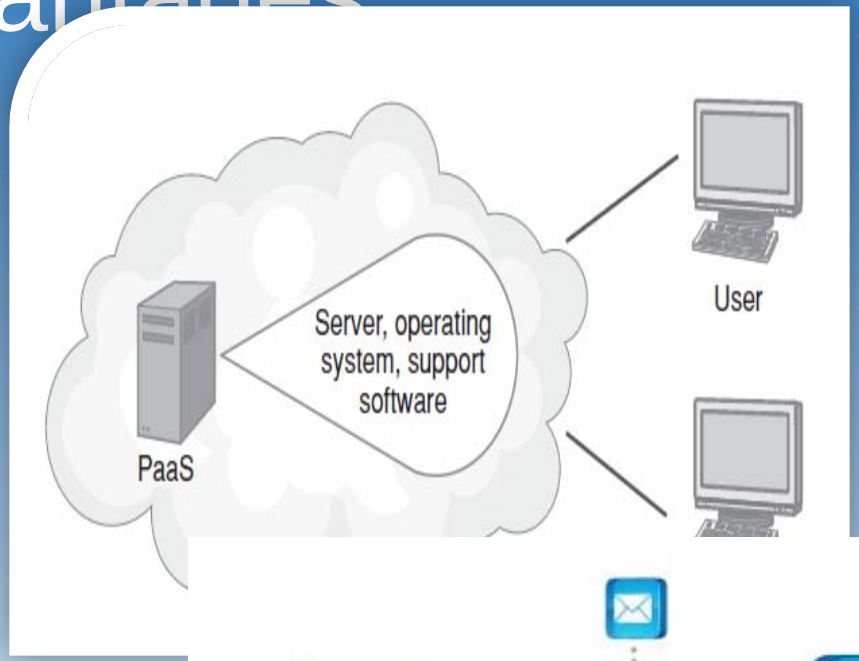
# Platform as a Service (PaaS)

- PaaS provides the underlying hardware technology
  - such as one or more servers (or virtual servers), operating systems, database solutions, developer tools, and network support, for developers to deploy their own solutions.
- Platform provider manages the hardware and software.
- Developers need not worry about performing hardware or operating system upgrades. Instead, developers can focus on their own applications.

# PaaS Advantages and Disadvantages

## Advantages

- Developers can focus on application solutions, not hardware or the platform.




## Disadvantages

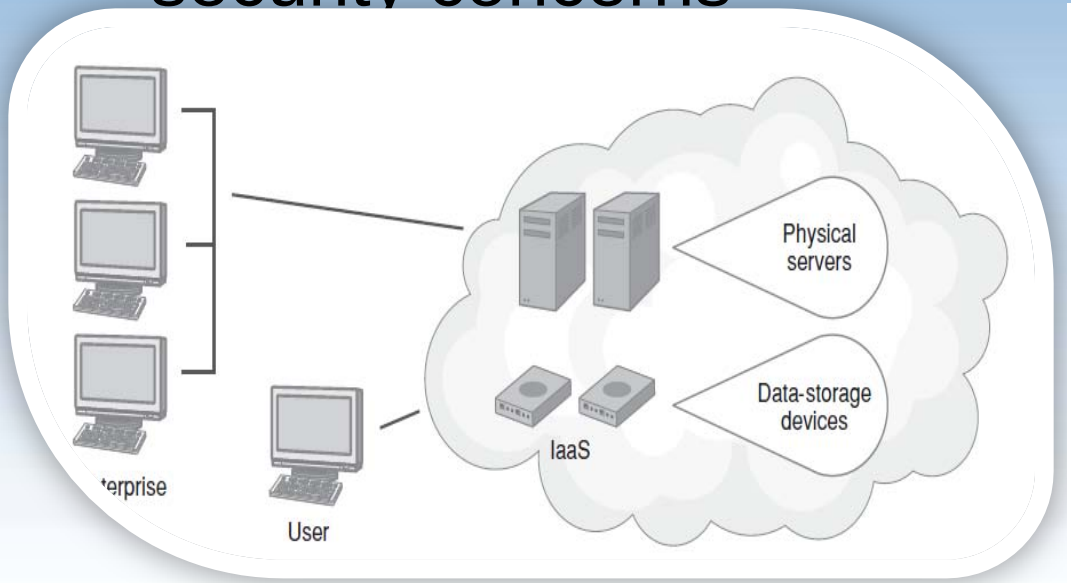
- Some developers want more control over the underlying systems (patches, versions, …)

# Infrastructure as a Service (IaaS)

- provides
  - a virtual data center within the cloud.
  - servers (physical and virtualized), cloud-based data storage, and more.
- Developers must install their own operating system, database management software, and support software.
- The developers (or the company's system administrators) must manage both the hardware and the software.

# IaaS Advantages and Disadvantages

- Advantage: Companies no longer require a data center
- Disadvantage: Some developers/administrators want to physically touch their equipment to reduce security concerns




# Real World: Amazon AWS

- Companies can use **Amazon Web Services (AWS)** to host their own systems.

- Today, AWS process hundreds of thousands of web-based requests for companies every second!

amazon web services

Sign Up | My Account / Console | Engli

AWS Products & Solutions | Entire Site | Developers | Support

# AWS Global Summit Series

Get up-to-speed on the latest AWS Cloud Computing services at these free events worldwide. Reserve your free seat today »


Get Started for Free » Pay only for what you use.

## What is AWS?

Customer Applications / AWS Marketplace

## Cost Savings with AWS


## Recent News

Announcements | Media Coverage

# Amazon : Web Service

- Amazon EC2 (Elastic Compute Cloud)
  - Small (Default): $0.10 per hour
  - All Data Transfer:  $0.10 per GB
- Amazon Simple Storage Service (Amazon S3)
  - $0.150 per GB – first 50 TB / month of storage used
  - $0.100 per GB – all data transfer in
  - $0.01 per 1,000 PUT, COPY, POST, or LIST requests
- Paying for What You Use

http://eblog.cisanet.org.tw/post/Cloud-Computing.aspx

amazon web services™

# AWS Price

## Storage Pricing

Region: US Standard

| | Standard Storage | Reduced Redundancy Storage | Glacier Storage |
|---|---|---|---|
| First 1 TB / month | $0.095 per GB | $0.076 per GB | $0.010 per GB |
| Next 49 TB / month | $0.080 per GB | $0.064 per GB | $0.010 per GB |
| Next 450 TB / month | $0.070 per GB | $0.056 per GB | $0.010 per GB |
| Next 500 TB / month | $0.065 per GB | $0.052 per GB | $0.010 per GB |
| Next 4000 TB / month | $0.060 per GB | $0.048 per GB | $0.010 per GB |
| Over 5000 TB / month | $0.055 per GB | $0.037 per GB | $0.010 per GB |

## Request Pricing

Region: US Standard

| | Pricing |
|---|---|
| PUT, COPY, POST, or LIST Requests | $0.01 per 1,000 requests |
| Glacier Archive and Restore Requests | $0.05 per 1,000 requests |
| Delete Requests | Free † |
| GET and all other Requests | $0.01 per 10,000 requests |
| Glacier Data Restores | Free †† |

† No charge for delete requests of Standard or RRS objects. For objects that are archived to Glacier, there is a pro-rated charge of $0.03 per gigabyte for objects deleted prior to 90 days. Learn more.

†† Glacier is designed with the expectation that restores are infrequent and unusual, and data will be stored for extended periods of time. You can restore up to 5% of your average monthly Glacier storage (pro-rated daily) for free each month. If you choose to restore more than this amount of data in a month, you are charged a restore fee starting at $0.01 per gigabyte. Learn more.


# Sign In or Create an AWS Account

**You may sign in using your existing Amazon.com account or you can create a new account by selecting "I am a new user."**

**Step 1**

**My e-mail address is:**

- **I am a new user.**
- **I am a returning user and my password is:**

Sign in using our secure server

Forgot your password?

Has your e-mail address changed?

Learn more about AWS Identity and Access Management and AWS Multi-Factor Authentication, features that provide additional security for your AWS Account.

amazon web services™

# Login Credentials

Use the form below to create login credentials that can be used for AWS as well as Amazon.com.

**Step 2**

**My name is:** Hsueh-Wen Tseng

**My e-mail address is:** d92005@csie.ntu.edu.tw

**Type it again:**

note: this is the e-mail address that we will use to contact you about your account

**Enter a new password:**

**Type it again:**

Continue

amazon web services™

Amazon Web Services Sign Up

CREATE ACCOUNT — PAYMENT METHOD — IDENTITY VERIFICATION — CONFIRMATION

**Step 3**

Your AWS account credentials have been created, but in order to begin using any of the services, you will need to provide your payment information and continue. There is no fee to sign up and you only pay for what you use.

## Enter Your Payment Information Below

Your credit card will not be charged until you begin using AWS, and many of your applications and uses of AWS may be able to operate within the AWS free usage tier. If your monthly usage goes beyond the free tier, your AWS service charges will be billed to the credit card you provide below. View detailed service pricing

* required fields

**Credit Card*:** Select card type

**Card Number*:**

**Cardholder's Name*:**

**Expiration Date*:** 01 2013

## Enter Your Billing Address

Select the billing address associated with your credit card.

- Use my contact address as my billing address
  (250 Kuo Kuang Road, Taichung, Taiwan 402, TW, +886-4-2284-0497)
- Enter a new address

Continue

amazon web services™

Amazon Web Services Sign Up

CREATE ACCOUNT ✓ — PAYMENT METHOD ✓ — IDENTITY VERIFICATION — CONFIRMATION

Step 4

In order to complete the sign up process, we will need to verify your identity.

## Identity Verification by Telephone

After you provide a telephone number where you can be reached below, you will then be called immediately by an automated system and prompted to enter the PIN number over the phone. Once completed, you'll be able to proceed to review your account details. Please follow the 3 simple steps below.

### 1. Provide a telephone number

Please enter your information below and click the "Call Me Now" button.

Country Code: Taiwan (+886) Phone number: +886-4-2284-0497 ext: 908

Call Me Now

### 2. Call in progress

### 3. Identity verification complete

amazon web services™

Amazon Web Services Sign Up

CREATE ACCOUNT ✓ — PAYMENT METHOD ✓ — IDENTITY VERIFICATION — CONFIRMATION

**Step 5**

In order to complete the sign up process, we will need to verify your identity.

## Identity Verification by Telephone

After you provide a telephone number where you can be reached below, you will then be called immediately by an automated system and prompted to enter the PIN number over the phone. Once completed, you'll be able to proceed to review your account details. Please follow the 3 simple steps below.

✓ Provide a telephone number

✓ Call to 886 886-4-2284-0497 x908

### 3. Identity verification complete

Your identity has been verified successfully

Continue

amazon web services™

Amazon Web Services Sign Up

CREATE ACCOUNT ✓ — PAYMENT METHOD ✓ — IDENTITY VERIFICATION ✓ — CONFIRMATION

**Step 6**

## Activating your account...

We are in the process of activating your account so that you can begin using AWS.

We will notify you by e-mail at **d92005@csie.ntu.edu.tw** once the verification is complete. You will then be able to begin using all AWS Infrastructure Services. For most customers, this process only takes a couple of minutes (but can sometimes take a few hours if additional account verification is required). As part of the account activation process, a $1 authorization will be placed on the payment method (normally, a Debit or Credit Card) to make sure your payment method is valid. **This authorization is not a charge**, but your bank may hold the authorized funds as unavailable until the authorization expires

## Start Exploring Amazon Web Services

- Products & Services
- Detailed Service Pricing
- Documentation
- FAQs
- Discussion Forums

## Protect your account with AWS Multi-Factor Authentication (MFA)

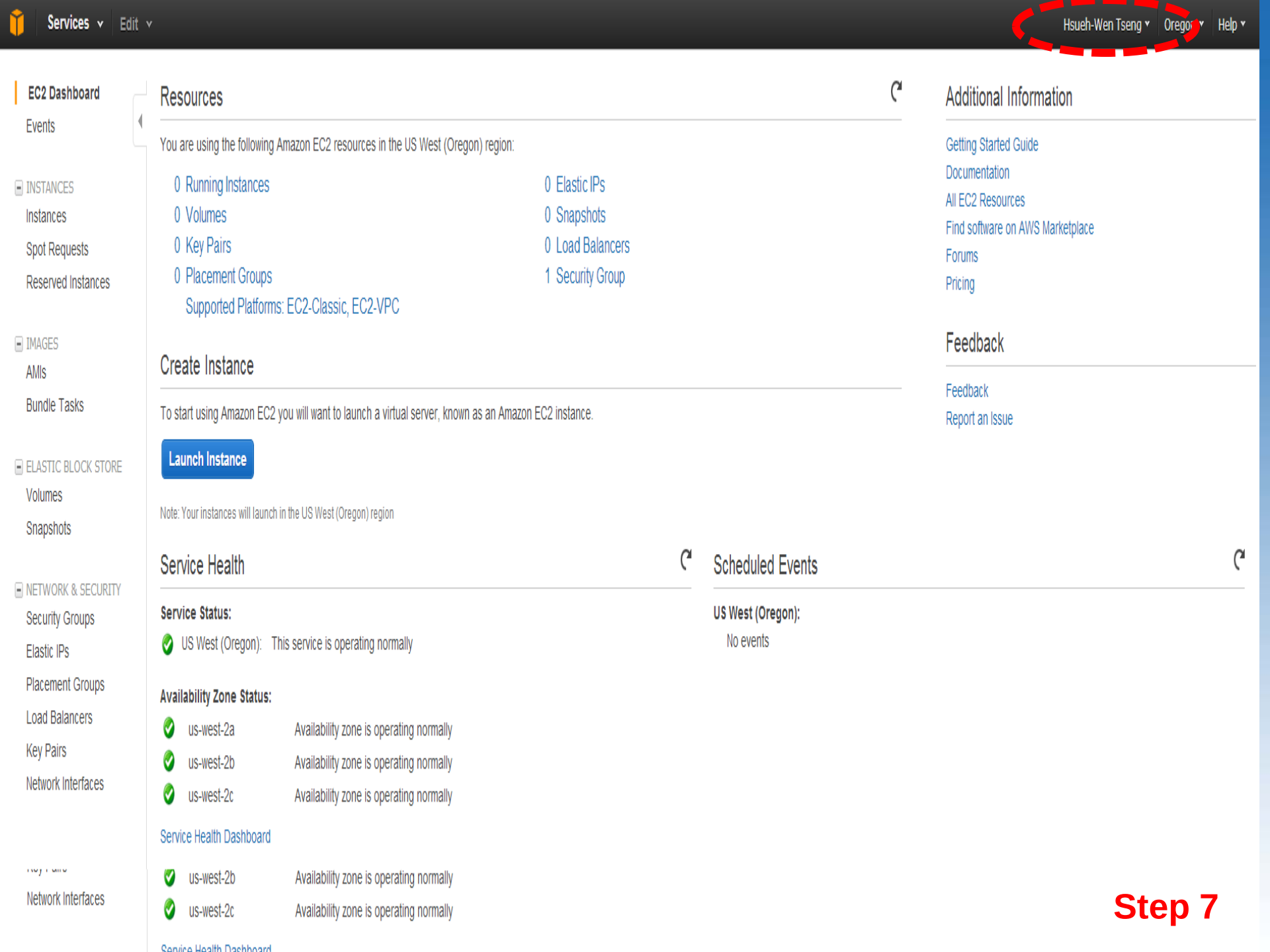
AWS MFA is a feature that is available at no extra cost that greatly enhances your account's security. In addition to your username and password, AWS MFA requires a one-time code from your MFA device when signing in to AWS web properties.

Activate MFA > Learn more

## Sign Up For AWS Support

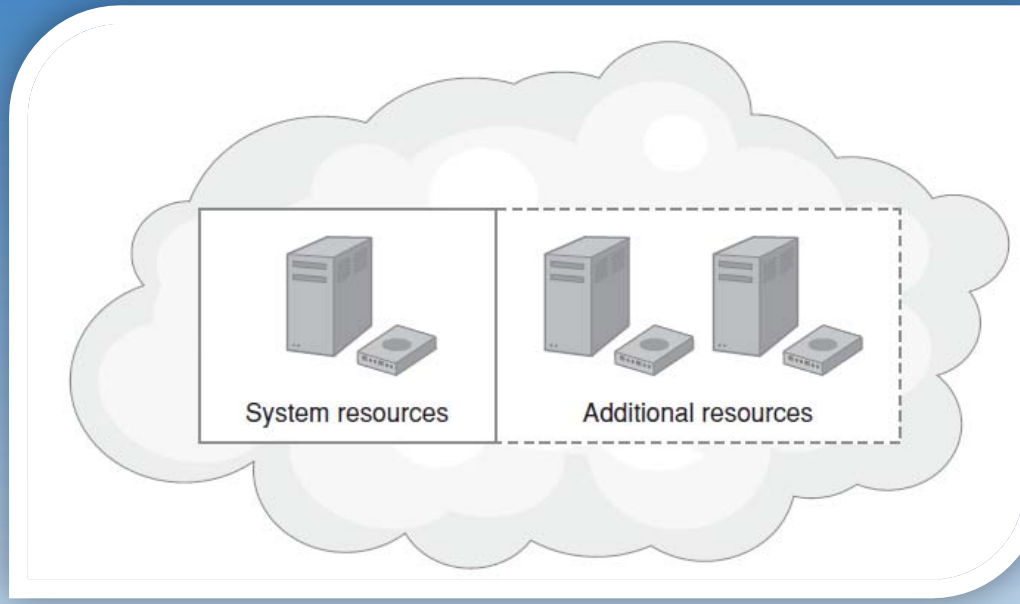
AWS Support is a one-on-one, fast response support channel to help you build and run applications on AWS. With pay-by-the-month pricing and an unlimited number of support cases, you are not constrained by long-term support contracts or limited support privileges.

Sign Up Now > Learn more


Services
Edit
Hsueh-Wen Tseng
Oregon
Help
EC2 Dashboard
Events
INSTANCES
Instances
Spot Requests
Reserved Instances
IMAGES
AMIs
Bundle Tasks
ELASTIC BLOCK STORE
Volumes
Snapshots
NETWORK & SECURITY
Security Groups
Elastic IPs
Placement Groups
Load Balancers
Key Pairs
Network Interfaces
Resources
You are using the following Amazon EC2 resources in the US West (Oregon) region:
0 Running Instances
0 Volumes
0 Key Pairs
0 Placement Groups
Supported Platforms: EC2-Classic, EC2-VPC
0 Elastic IPs
0 Snapshots
0 Load Balancers
1 Security Group
Create Instance
To start using Amazon EC2 you will want to launch a virtual server, known as an Amazon EC2 instance.
Launch Instance
Note: Your instances will launch in the US West (Oregon) region
Service Health
Service Status:
US West (Oregon): This service is operating normally
Availability Zone Status:
us-west-2a Availability zone is operating normally
us-west-2b Availability zone is operating normally
us-west-2c Availability zone is operating normally
Service Health Dashboard
us-west-2b Availability zone is operating normally
us-west-2c Availability zone is operating normally
Scheduled Events
US West (Oregon):
No events
Additional Information
Getting Started Guide
Documentation
All EC2 Resources
Find software on AWS Marketplace
Forums
Pricing
Feedback
Feedback
Report an Issue
Step 7

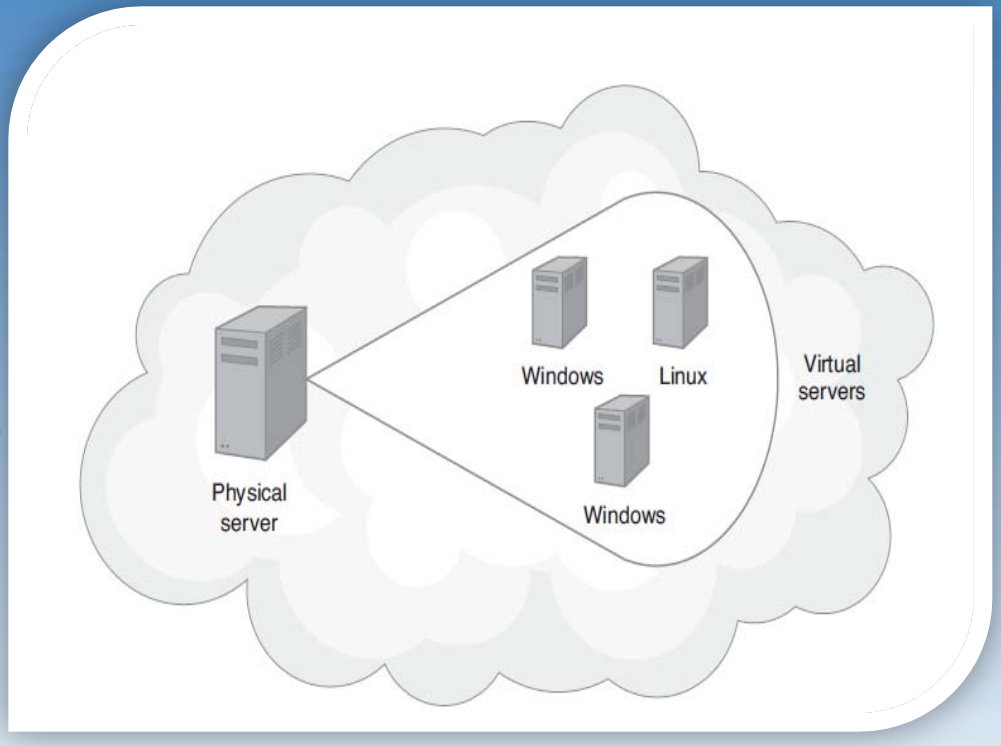
# Scalability

- A site or application's ability to use additional resources on demand.
- The site or application may scale up to utilize additional resources when the system is experiencing high user demand and later scale down resources when the demand declines.



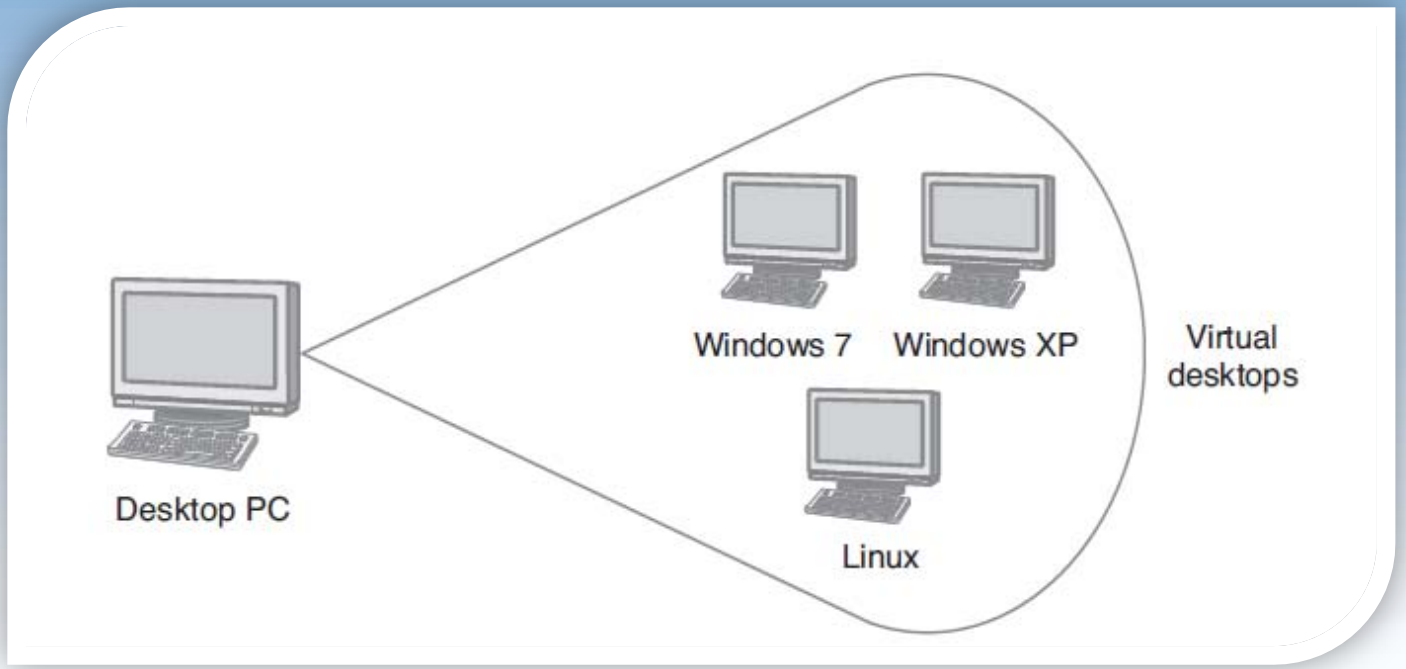
# Virtualization

- The use of hardware and/or software to create the perception of something.
- Using special software, the server can be made to appear as if it has multiple CPUs running the same or different operating systems.



# Desktop Virtualization

- Allows a desktop PC to run multiple operating systems.
- Ideal for testers or support personnel.



# Process vs. System VMs

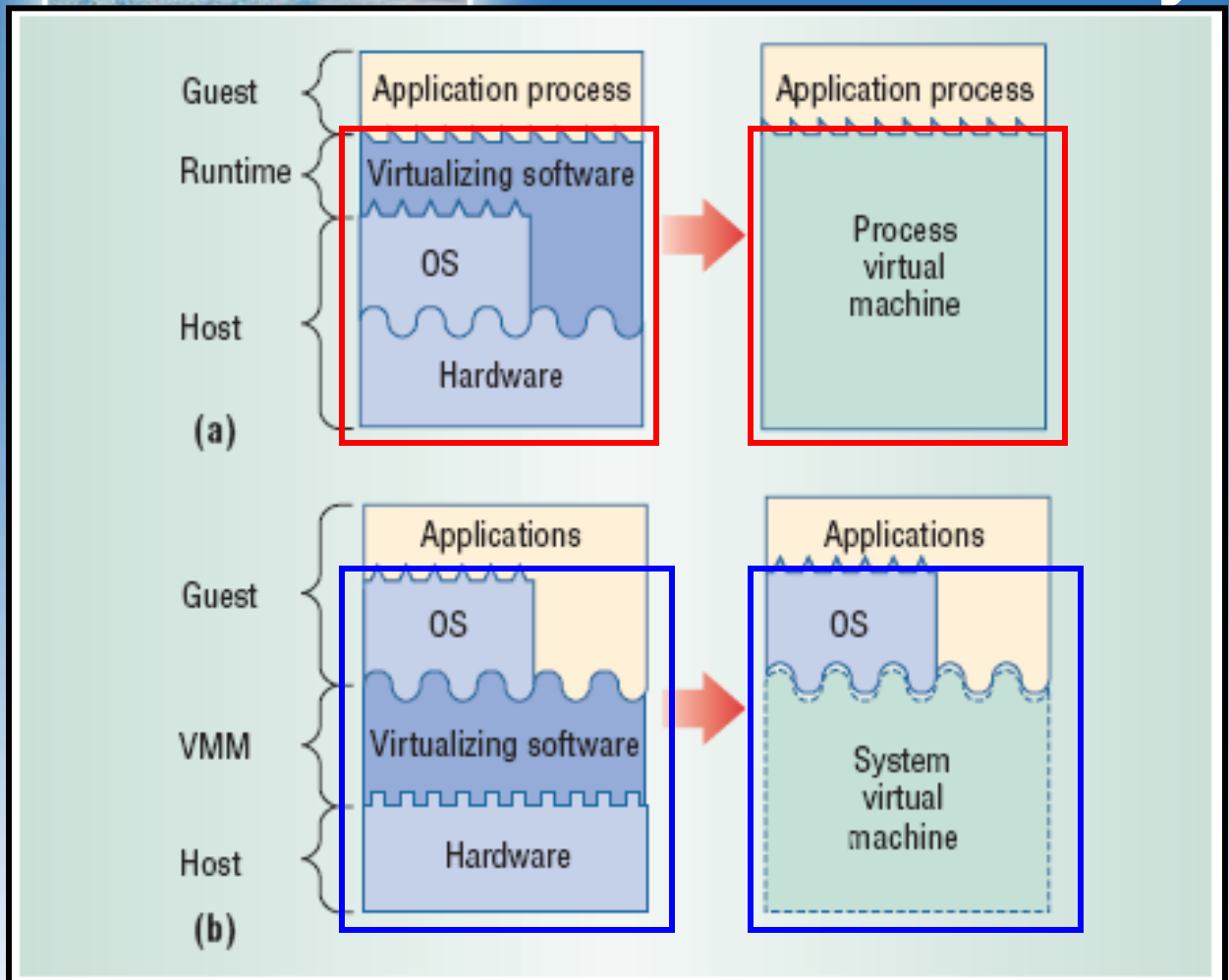
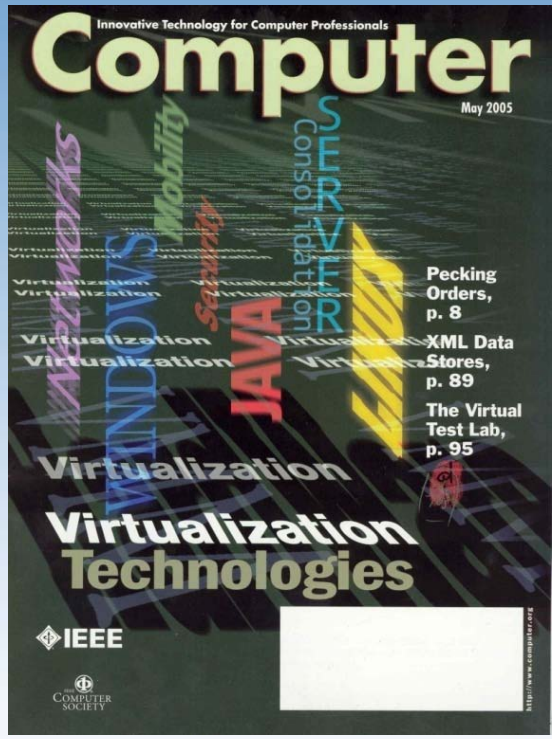



*Figure 3. Process and system VMs. (a) In a process VM, virtualizing software translates a set of OS and user-level instructions composing one platform to those of another. (b) In a system VM, virtualizing software translates the ISA used by one hardware platform to that of another.*

- In Smith and Nair's "The architecture of Virtual machines", Computer, May 2005



# Process VM

- A process virtual machine (also, language virtual machine) is designed to run a single program, which means that it supports a single process.
  - Such virtual machines are usually closely suited to one or more programming languages and built with the purpose of providing program portability and flexibility (amongst other things).
  - An essential characteristic of a virtual machine is that the software running inside is limited to the resources and abstractions provided by the virtual machine—it cannot break out of its virtual environment.

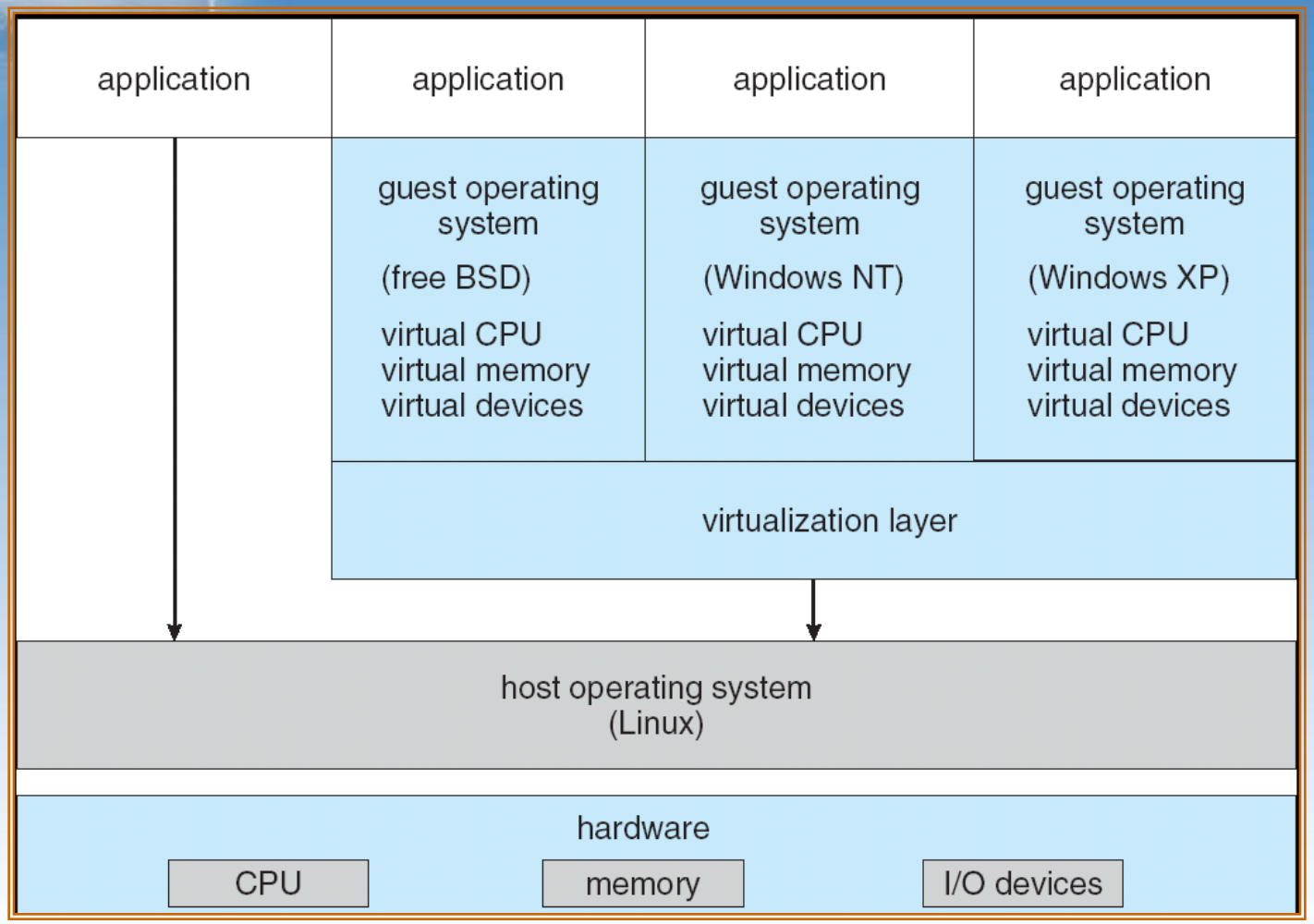
# System VM

- A system virtual machine provides a complete system platform which supports the execution of a complete operating system (OS).
  - These usually emulate an existing architecture, and are built with the purpose of either providing a platform to run programs where the real hardware is not available for use (for example, executing on otherwise obsolete platforms), or of having multiple instances of virtual machines leading to more efficient use of computing resources, both in terms of energy consumption and cost effectiveness (known as hardware virtualization, the key to a cloud computing environment), or both.

# VMware – Modern Virtual Machine System

- Founded 1998, Mendel Rosenblum *et al.*
  - Research at Stanford University
- VMware Workstation
  - Separates Host OS from virtualization layer
  - Host OS may be Windows, Linux, etc.
  - Wide variety of Guest operating systems
  - < $200
- http://www.vmware.com/

# VMware Architecture



# VMware Server

- Free version released in 2006
  - http://www.vmware.com/products/server/
  - Runs on any x86 server hardware and OS
  - Windows Server and Linux Host OS's
- Partition a physical server into multiple virtual server machines
  - Target market – IT centers providing multiple services
  - Allows separate virtual servers to be separately configured for separate IT applications
  - Portability, replication, etc.

# VMware Server ESX

- Total decoupling between hardware and applications
- High-end, high-performance IT applications
  - Oracle, SQL Server, Microsoft Exchange server, SAP, Siebel, Lotus Notes, BEA WebLogic, Apache
- Dynamically move running application to different hardware
  - Maintenance, hardware replacement
  - Provisioning new versions, etc.

VMware ESX is an enterprise-level computer virtualization product offered by VMware

# Key Terms

## Key Terms

Amazon Web Services (AWS)
Cloud computing
Community cloud
Grid computing
Hybrid cloud
iCloud
Infrastructure as a service (IaaS)
Platform as a service (PaaS)
Private cloud
Public cloud
Reliability
Robust
Scalability
Software as a service (SaaS)
Virtualization
Web 2.0
Windows Azure

# Chapter Review

**1.** Define and discuss cloud computing.

**2.** Discuss how cloud computing has changed how companies budget for software solutions.

**3.** Compare and contrast SaaS, PaaS, and IaaS, and provide an example of each.

**4.** Define scalability and discuss how the cloud impacts it.

**5.** List three advantages and three disadvantages of cloud computing.

# Chapter Review Continued

**6.** Define virtualization and discuss how the cloud impacts it.

**7.** Describe three cloud-based solutions for individuals and three cloud-based solutions for businesses.

**8.** Discuss how Web 2.0 has driven the growth of the web.

**9.** Compare and contrast public, private, community, and hybrid clouds.