# Chapter 4

# IT Infrastructure: Hardware and Software

**Video Cases:**
Case 1 Hudson's Bay Company and IBM: Virtual Blade Platform
Case 2 Salesforce.com: SFA on the iPhone and iPod Touch

**Instructional Videos:**
Instructional Video 1 Google and IBM Produce Cloud Computing
Instructional Video 2 IBM Blue Cloud is Ready-to-Use Computing


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## STUDENT LEARNING OBJECTIVES

- What are the components of IT infrastructure?
- What are the major computer hardware, data storage, input, and output technologies used in business?
- What are the major types of computer software used in business?


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## STUDENT LEARNING OBJECTIVES

- What are the most important contemporary hardware and software trends?
- What are the principal issues in managing hardware and software technology?


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## BART Speeds Up with a New IT Infrastructure

- **Problem:** Aging systems no longer able to provide information rapidly enough for timely decisions; too unreliable for 24/7 operations

- **Solution:** Replace and upgrade hardware and software and used leading-edge technology

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## BART Speeds Up with a New IT Infrastructure

- **Oracle's PeopleSoft Enterprise applications** replaced legacy applications. Used blade servers, grid architecture, and virtualization, increasing server capacity utilization to 50% or more.
- Demonstrates IT's role in using resources more efficiently, reducing computer energy usage, modernizing services.


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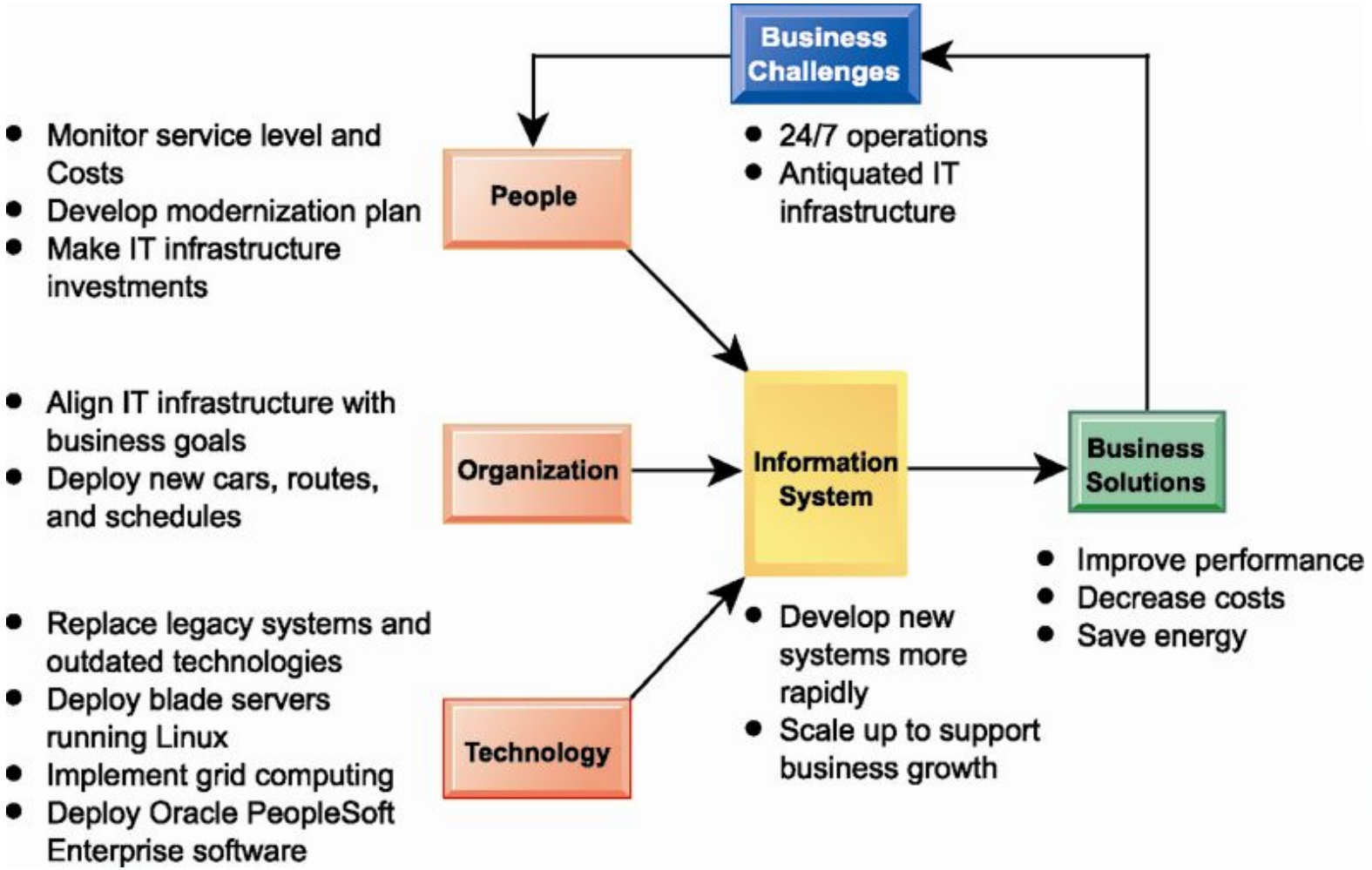
## BART Speeds Up with a New IT Infrastructure





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# Infrastructure Components

- **IT infrastructure:** provides platform for supporting all information systems in the business
  - **Computer hardware**
  - **Computer software**
  - **Data management technology**
    - Organizes, manages, and processes business data concerned with inventory, customers, and vendors
  - **Networking and telecommunications technology**
  - **Technology services**
    - E.g., consultants for systems integration with legacy systems


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# IT Infrastructure Components

**A firm's IT infrastructure is composed of hardware, software, data management technology, networking technology, and technology services.**

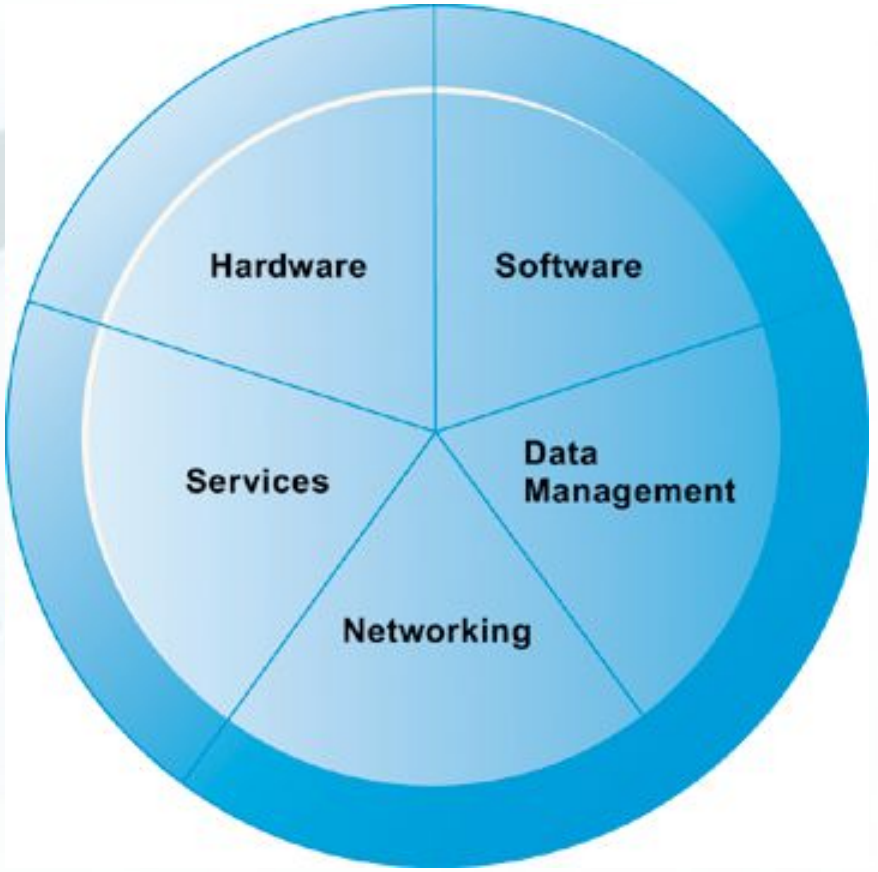


**Figure 4-1**


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# Types of Computers

- **Computers come in different sizes with varying capabilities for processing information**
- **Mobile devices**
- **PCs**
- **Workstations**
  - More powerful mathematical and graphics-processing capabilities than a PC


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# Types of Computers

- **Servers:**
  - Support computer network, sharing files, and resources
  - Provide hardware platform for e-commerce
- **Mainframes:**
  - Large-capacity, high-performance computer that can process large amounts of data very rapidly
  - E.g., used by airlines to handle thousands of reservations per second


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# Types of Computers

- **Supercomputer:**
  - More sophisticated computer used for tasks requiring extremely rapid and complex calculations with thousands of variables, millions of measurements
  - Used in engineering, scientific simulations, military/weapons research, weather forecasting
- **Grid computing:**
  - Power of geographically remote computers connected into single network to act as “virtual supercomputer”


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# Types of Computers

- **Client/server computing:**
  - Form of distributed computing
  - Splits processing between “clients” and “servers”
  - **Clients:** user point of entry
  - **Servers:** store and process shared data and perform network management activities


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# Types of Computers

- **Client/server computing (cont.):**
  - **Two-tiered client/server architecture**
    - Uses two types of machines
  - **Multi-tiered client/server architecture (N-tier)**
    - Balances load of network over several levels of servers
    - E.g., Web servers and application servers


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IT Infrastructure: Computer Hardware

# Client/Server Computing

**In client/server computing, computer processing is split between client machines and server machines linked by a network. Users interface with the client machines.**

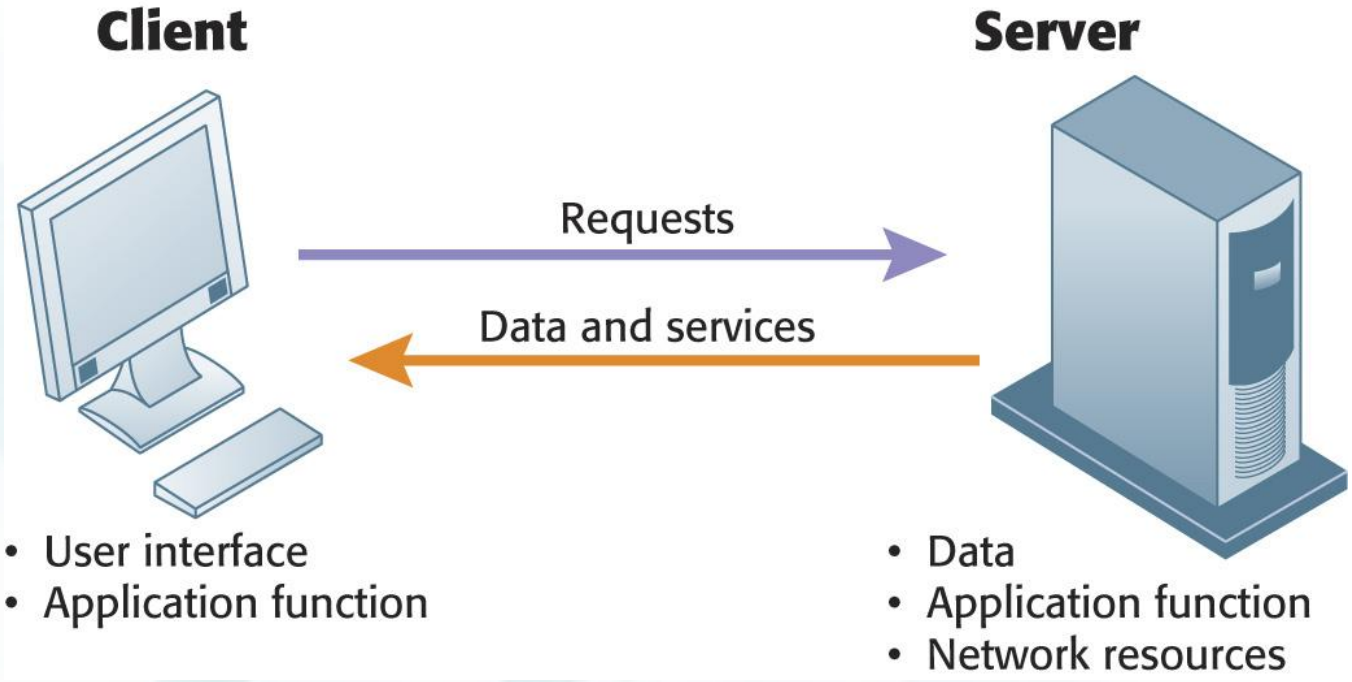


**Figure 4-2**


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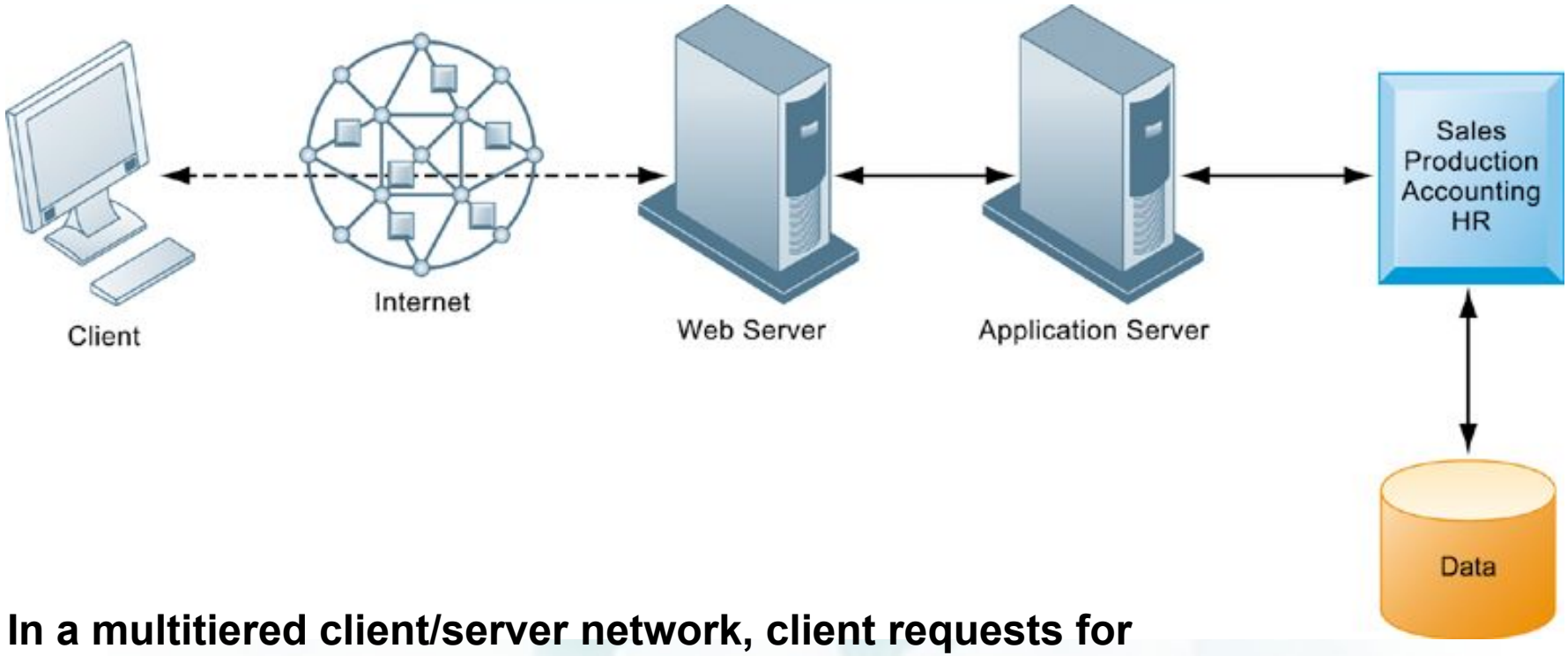
IT Infrastructure: Computer Hardware

# A Multitiered Client/Server Network (N-Tier)




**In a multitiered client/server network, client requests for service are handled by different levels of servers.**

**Figure 4-3**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## Storage, Input, and Output Technology

- Primary secondary storage technologies
  - Magnetic disk:
    - Hard drives, USB flash drives
    - RAID: can package hundreds of drives for massive storage requirements
  - Optical disks
    - CD-ROM, CD-RW, DVD, DVD-RW
  - Magnetic tape
  - Storage networking: SANs
    - Connect multiple storage devices on a separate high-speed network dedicated to storage


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# A Storage Area Network (SAN)

A typical SAN consists of a server, storage devices, and networking devices, and is used strictly for storage. The SAN stores data on many different types of storage devices, providing data to the enterprise. The SAN supports communication between any server and the storage unit as well as between different storage devices in the network.

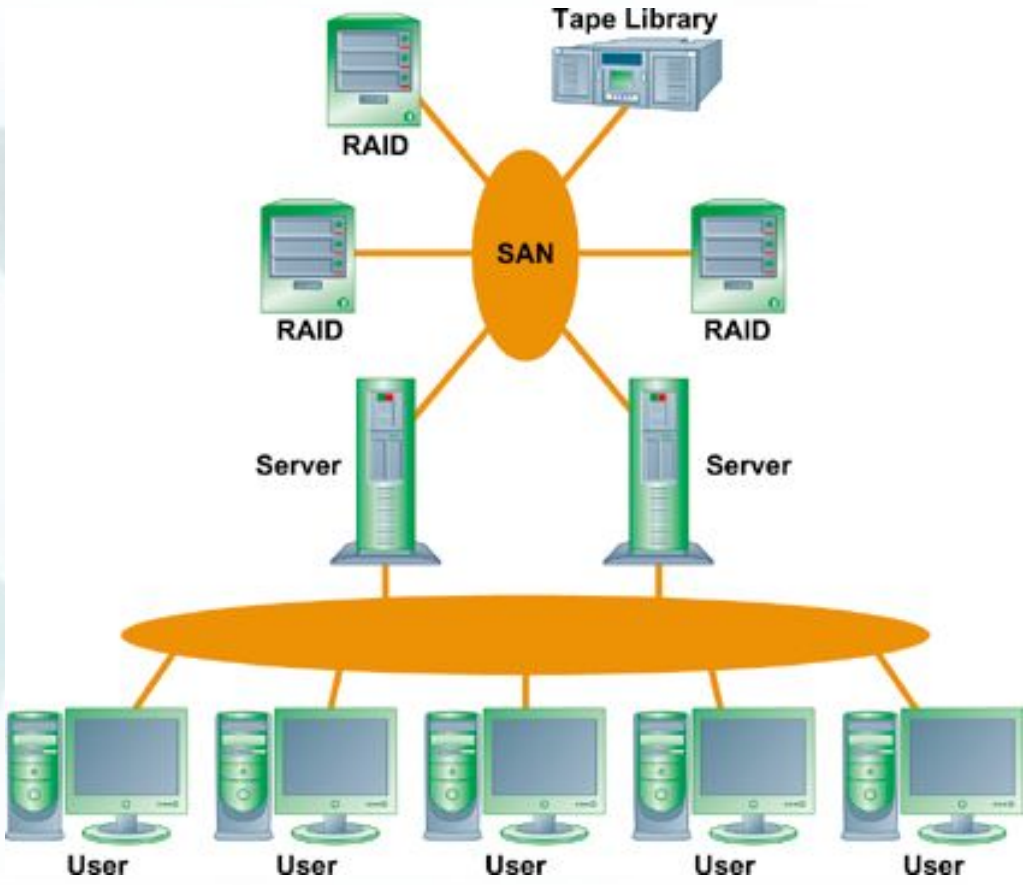


Figure 4-4


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## Storage, Input, and Output Technology

- **Input devices:**
  - Gather data and convert them into electronic form
    - Keyboard
    - Computer mouse
    - Touch screen
    - Optical character recognition
    - Magnetic ink character recognition
    - Pen-based input
    - Digital scanner
    - Audio input
    - Sensors


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## Storage, Input, and Output Technology

- **Output devices:**
  - Display data after they have been processed
    - Monitor
      - Flat-panel, CRT
    - Printer
      - Impact, nonimpact
    - Audio output


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# Contemporary Hardware Trends

- **The emerging mobile digital platform**
  - Cell phones, smartphone
  - Netbooks and tablet computers
  - E-book readers
- **Nanotechnology**
  - Creating computer chips and other devices thousands of times smaller through manipulating individual atoms, molecules


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# Examples of Nanotubes

Nanotubes are tiny tubes about 10,000 times thinner than a human hair. They consist of rolled up sheets of carbon hexagons, have potential uses as minuscule wires or in ultra-small electronic devices, and are very powerful conductors of electrical current.

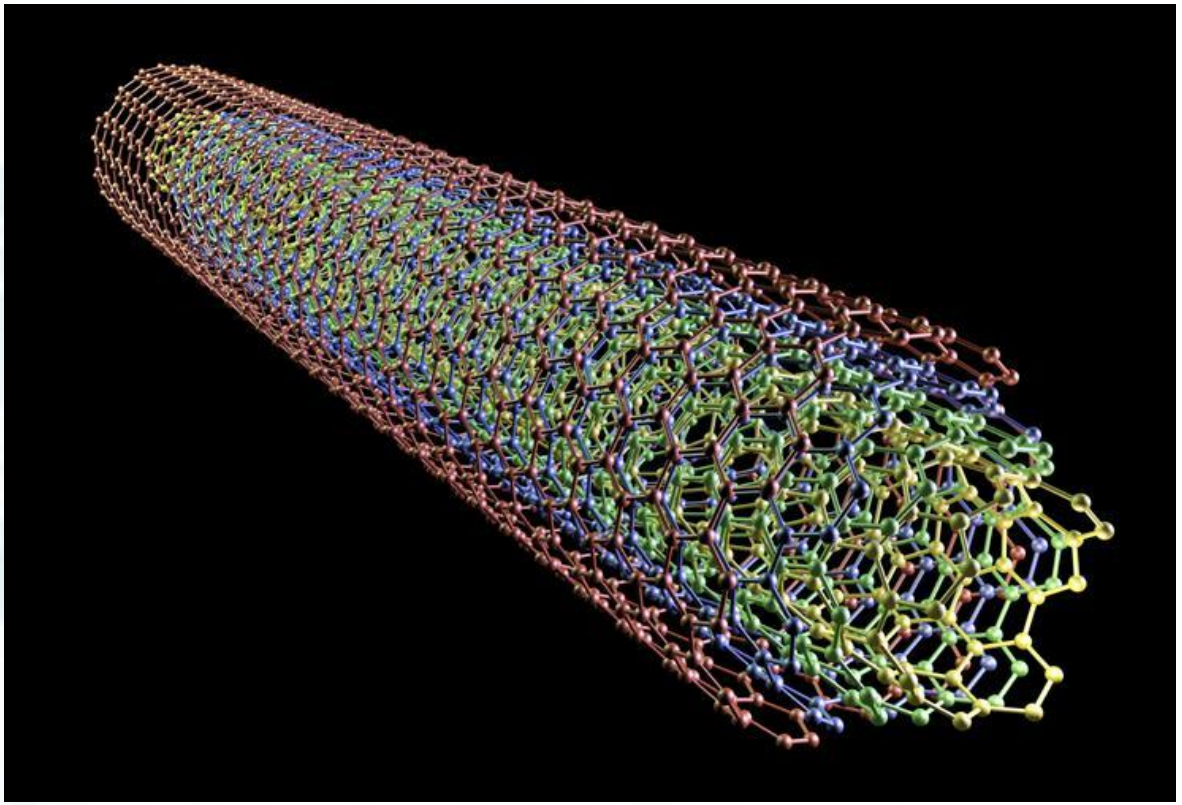

Figure 4-5


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## Contemporary Hardware Trends

- **Virtualization:**
  - Process of presenting a set of computing resources so they can be accessed in ways that are unrestricted by physical configuration or geographic location
  - **Server virtualization:** running more than one operating system at the same time on single machine


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## Contemporary Hardware Trends

- **Cloud Computing:**
  - A model of computing in which firms and individuals obtain computing resources over the Internet
    - Cloud infrastructure as a service
    - Cloud platform as a service
    - Cloud software as a service
  - Public vs. private clouds
  - Utility computing, on-demand computing
  - Data storage security is in hands of provider


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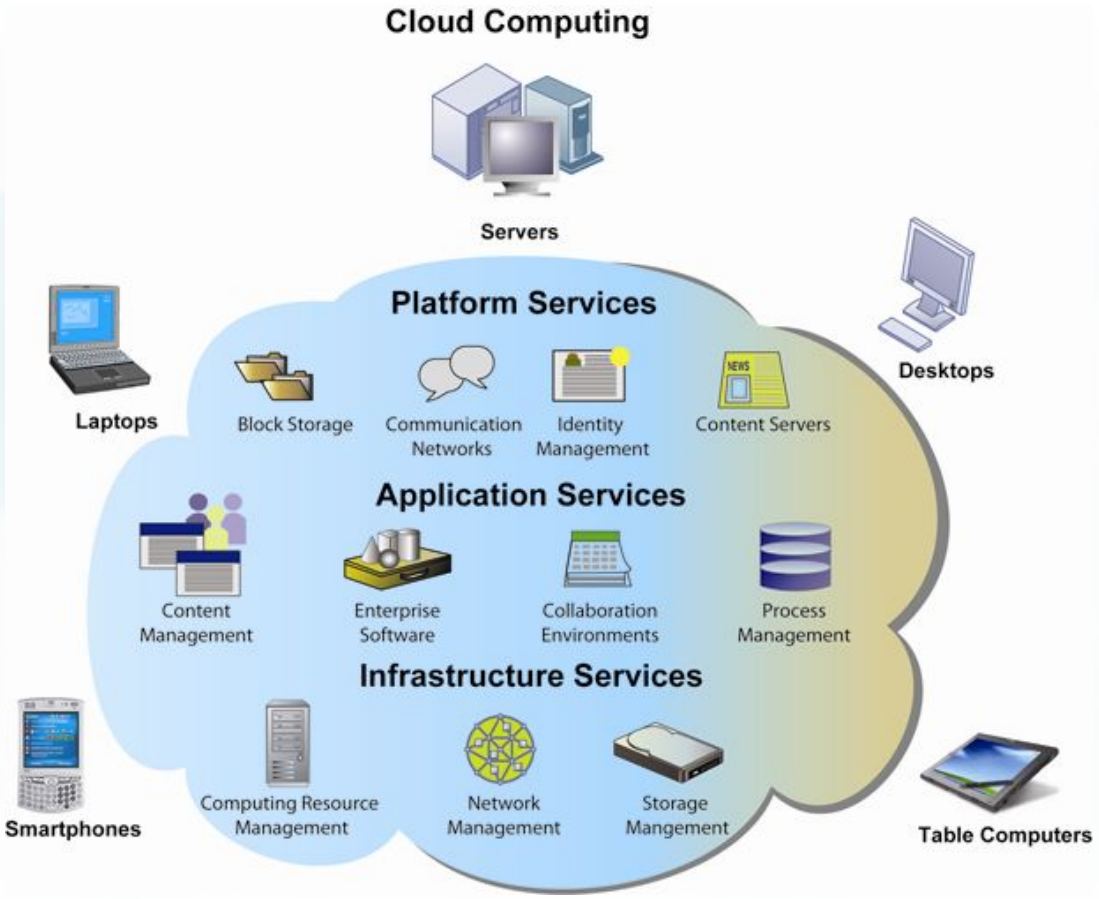
## IT Infrastructure: Computer Software

# Cloud Computing Platform

**Figure 4-6**

**In cloud computing, hardware and software capabilities are provided as services over the Internet. Businesses and employees have access to applications and IT infrastructure anywhere at any time using an Internet-connected device.**





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# Contemporary Hardware Trends

- **Green computing**
  - Practices and technologies for designing, making, using, and disposing of computer hardware
  - Key priority is power reduction
  - IT in U.S. provides 2% of U.S. power demand and 2% of world's greenhouse gases


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# Interactive Session: Organizations
# Green Data Centers: Good for Business?

- **Read the Interactive Session and then discuss the following questions:**
  - **What business and social problems does data center power consumption cause?**
  - **What solutions are available for these problems? Which are the most environment-friendly?**
  - **What are the business benefits and costs of these solutions?**
  - **Should all firms move toward green computing? Why or why not?**


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## Contemporary Hardware Trends

- **High-performance and power-saving processors**
  - Multicore processor:
    - Integrated circuit with two or more processors
    - Enhanced performance and reduced power consumption
  - Power-efficient processors
    - Low power consumption essential in mobile computing


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## Contemporary Hardware Trends

- **Autonomic computing:**
  - Development of systems that can configure themselves, heal themselves; e.g., self-updating antivirus software


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IT Infrastructure: Computer Software

# The Major Types of Software

The relationship among the system software, application software, and users can be illustrated by a series of nested boxes. System software—consisting of operating systems, language translators, and utility programs—controls access to the hardware. Application software, including programming languages and "fourth-generation" languages, must work through the system software to operate. The user interacts primarily with the application software.

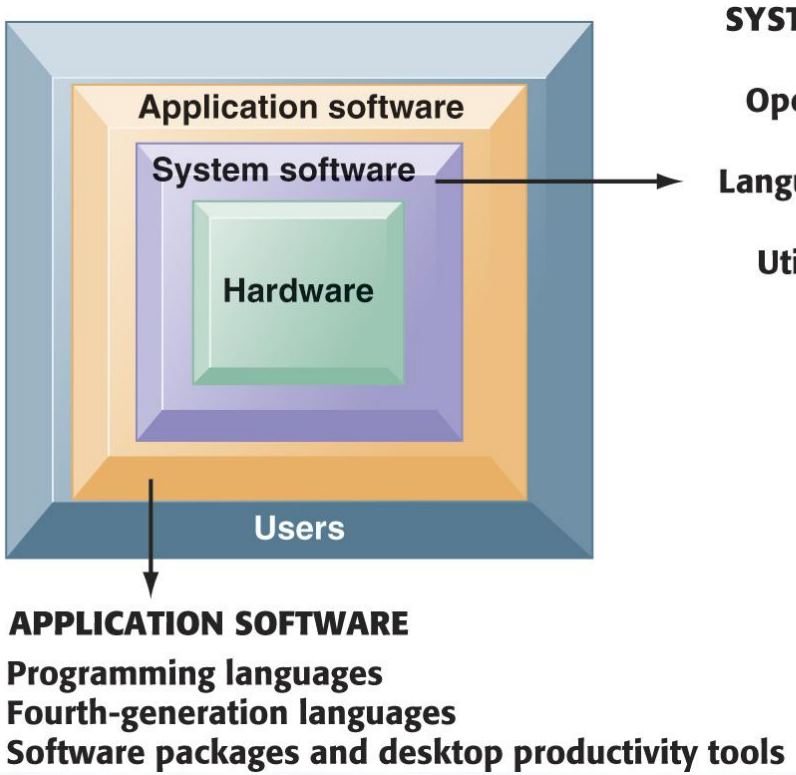


Figure 4-7


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# Operating System Software

- The software that controls computer activities
- GUIs and multitouch
- PC operating systems
  - Windows (Windows 8)
  - Mac (OSX Lion)
  - UNIX
  - Linux (open source)
- Mobile operating systems
  - Chrome, Android, iOS


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# Application Software and Desktop Productivity Tools

- **Application programming languages for business**
  - COBOL
  - C, C++
  - Visual Basic: Visual programming language
- **Fourth-generation languages**
  - Software tools that enable end-users to develop software applications
  - Tend to be nonprocedural, may use natural languages


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# Categories of Fourth-Generation Languages

| Tool | Description | Example |
|---|---|---|
| **PC software tools** | General-purpose software packages for PCs | WordPerfect<br>Microsoft Access |
| **Query language** | Languages for retrieving data stored in databases or files | SQL |
| **Report generator** | Specialized tools for creating highly customized reports | Crystal Reports |
| **Graphics language** | Display data from databases in graphic format | SAS Graph<br>Systat |
| **Application generator** | Preprogrammed modules to generate entire applications | WebFOCUS<br>QuickBase |
| **Application software package** | Software programs that eliminate need for custom, in-house software | Oracle PeopleSoft HCM<br>mySAP ERP |


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## Application Software and Desktop Productivity Tools

- **Software packages and desktop productivity tools**
  - **Word processing software**
  - **Spreadsheet software**
  - **Data management software**
  - **Presentation graphics**
  - **Software suites**
  - **Web browsers**


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IT Infrastructure: Computer Software

# Spreadsheet Software

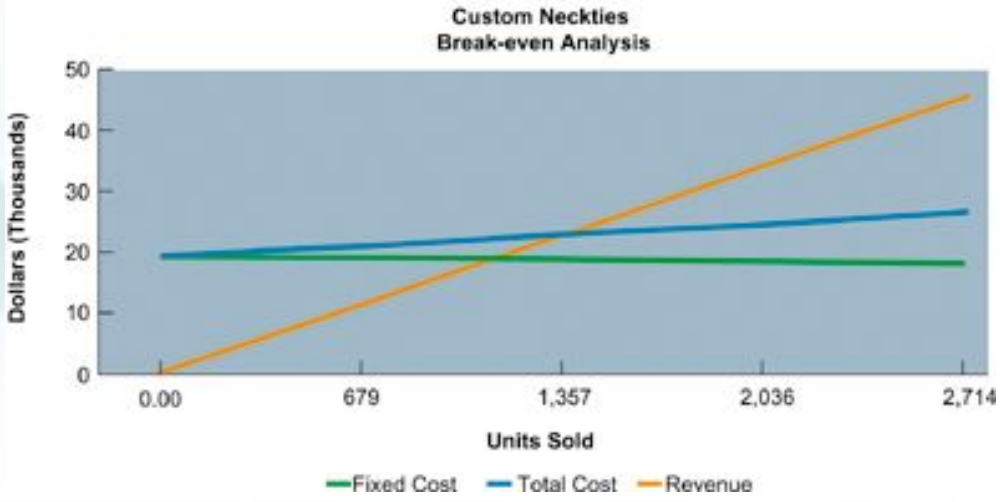
Figure 4-8

Spreadsheet software organizes data into columns and rows for analysis and manipulation. Contemporary spreadsheet software provides graphing abilities for a clear, visual representation of the data in the spreadsheets. This sample break-even analysis is represented as numbers in a spreadsheet as well as a line graph for easy interpretation.

| | |
|---|---|
| Total fixed cost | 19,000.00 |
| Variable cost per unit | 3.00 |
| Average sales price | 17.00 |
| Contribution margin | 14.00 |
| Break-even point | 1,357 |

Custom Neckties Pro Forma Income Statement

| | | | | | |
|---|---|---|---|---|---|
| Units sold | 0.00 | 679 | 1,357 | 2,036 | 2,714 |
| Revenue | 0 | 11,536 | 23,071 | 34,607 | 46,143 |
| Fixed cost | 19,000 | 19,000 | 19,000 | 19,000 | 19,000 |
| Variable cost | 0 | 2,036 | 4,071 | 6,107 | 8,143 |
| Total cost | 19,000 | 21,036 | 23,071 | 25,107 | 27,143 |
| Profit/Loss | (19,000) | (9,500) | 0 | 9,500 | 19,000 |





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## Software for the Web: Java and HTML

- Java:
  - Operating system-independent, processor-independent, object-oriented programming language
- Hypertext markup language (HTML):
  - Page description language for specifying how elements are placed on a Web page and for creating links to other pages and objects
- HTML5
  - Next evolution of HTML
  - Enables multimedia embedding without 3rd party add-ons like Flash


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# Web Services

- **Web services:**
  - Software components that exchange information with one another using universal Web communication standards and languages
  - **XML (eXtensible Markup Language)**
    - Foundation of Web services
  - **Service oriented architecture (SOA)**
    - Collection of services used to build an organization's software systems


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# How Dollar Rent-A-Car Uses Web Services

Dollar Rent-A-Car uses Web services to provide a standard intermediate layer of software to "talk" to other companies' information systems. Dollar Rent-A-Car can use this set of Web services to link to other companies' information systems without having to build a separate link to each firm's systems.

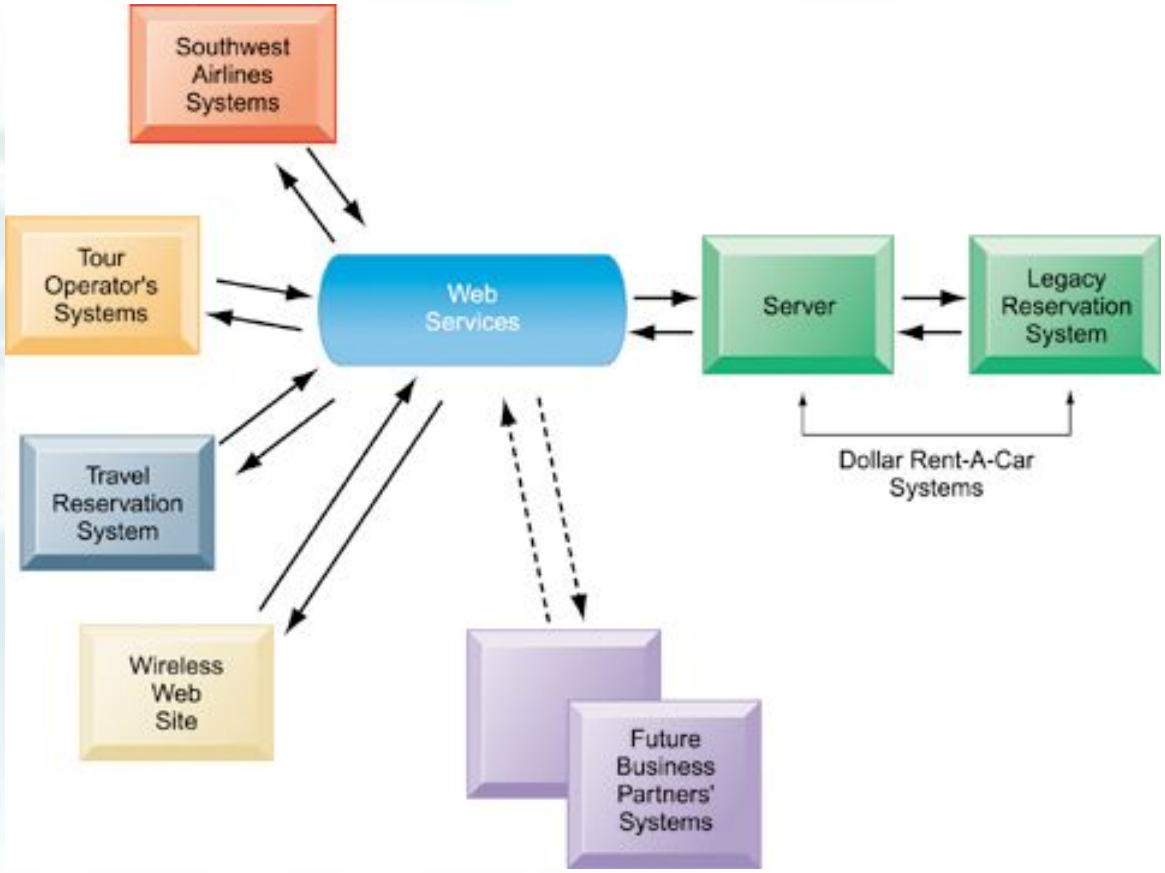


Figure 4-9


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# Software Trends

- **Open source software**
  - Linux, Apache
- **Cloud-based software and tools**
  - SaaS (software as a service)
    - Google Docs
  - Mashups
    - Zip Realty uses Google Maps and Zillow.com
  - Apps
    - Mobile apps


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## Managing Hardware and Software Technology

- **Capacity planning**
  - **Process of predicting when hardware system becomes saturated**
  - **Ensuring firm has enough computing power for current and future needs**
  - **Factors include:**
    - Maximum number of users
    - Impact of current, future software
    - Performance measures
- **Scalability:** ability of system to expand to serve large number of users without breaking down


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## Managing Hardware and Software Technology

- **Total Cost of Ownership (TCO) model**
  - Used to analyze direct and indirect costs to help determine the actual cost of owning a specific technology
    - **Direct costs: hardware, software purchase costs**
    - **Indirect costs: ongoing administration costs, upgrades, maintenance, technical support, training, utility, and real estate costs**
    - **Hidden costs: support staff, downtime, additional network management**
  - TCO can be reduced through increased centralization, standardization of hardware, and software resources


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- **Using technology service providers**
  - **Outsourcing**
    - Using external provider to:
      - Run networks
      - Host, manage Web site(s)
      - Develop software (**offshore software outsourcing**)
      - Manage IT infrastructures
    - Requires **Service Level Agreements (SLAs)**


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## Managing Hardware and Software Technology

- **Using cloud services**
  - **Small businesses "rent" infrastructure from another firm to avoid expenses of maintaining hardware and software on their own**
    - **Off-loading peak demand to remote data centers**
- **Managing mobile platforms**
  - **Balancing gains in productivity from using mobile devices with expenses of equipping employees with these devices**
    - **TCO for wireless devices ranges from $1,000 to 3,000**


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- **Managing software localization for global business**
  - Local language interfaces
    - English not typically standard at middle, lower levels
    - Interfaces are complex: menu bars, error messages, online forms, search results, and so on
  - Differences in local cultures
  - Differences in business processes
- All of these factors add to TCO of using technology service providers


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# Interactive Session: People
# Should You Use Your iPhone for Work?

- Read the Interactive Session and then discuss the following questions:
  - What are the advantages and disadvantages of allowing employees to use their personal smartphones for work?
  - What people, organization, and technology issues should be addressed when deciding whether to allow employees to use personal smartphones for work?
  - Allowing employees to use their own smartphones for work will save the company money. Do you agree? Why or why not?


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