

# **IT Infrastructure: Hardware and Software**

## **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?**
- **What are the most important contemporary hardware and software trends?**
- **What are the principal issues in managing hardware and software technology?**
- **What is the meaning of Moore's Law**

## IT Infrastructure: Computer Hardware

### 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

## IT Infrastructure: Computer Hardware

### IT Infrastructure Components

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

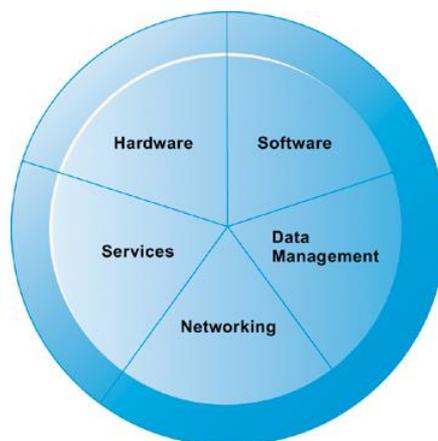


Figure 4-1

## Moore's Law

- Moore's Law predicts that the number of transistors fitting on a computer chip will double every one and a half to two years.
- This prediction about density also captures advances in processing speed, storage capabilities, cost, and other component features.
- Processing power and speed and storage capabilities have increased exponentially as the cost of computing devices has decreased.
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### IT Infrastructure: Computer Hardware

#### Types of Computers

- **Computers come in different sizes with varying capabilities for processing information.**
  - FLOPS (Floating point operations per second)
- **Smartphones, netbooks, e-book readers**
  - Today's smartphones are far more powerful than the early PCs of the 1980s
- **PCs**
- **Workstations**
  - More powerful mathematical and graphics-processing capabilities than a PC
  - Used primarily for advanced design or engineering work requiring powerful graphics or computational capabilities.

## IT Infrastructure: Computer Hardware

### Types of Computers

- **Servers:**
  - Type of midrange computer.
  - 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 for thousands of reservations per second
  - Mainframes are still a major revenue and profit source for IBM, one of the last large-scale commercial manufacturers of mainframe computers. They are used often as huge Web servers where they are more efficient than tens of thousands of PCs in processing large volumes of records

## IT Infrastructure: Computer Hardware

### 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:** [Video](#)
  - Power of geographically remote computers connected into single network to act as “virtual supercomputer”

## IT Infrastructure: Computer Hardware

### Types of Computers

- **Client/server computing:**
  - Form of distributed computing
  - Splits processing between “clients” and “servers”
  - **Clients:** user point of entry
    - The user generally interacts directly only with the client portion of the application, often to input data or retrieve data for further analysis.
  - **Servers:** store and process shared data and perform network management activities

## 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.

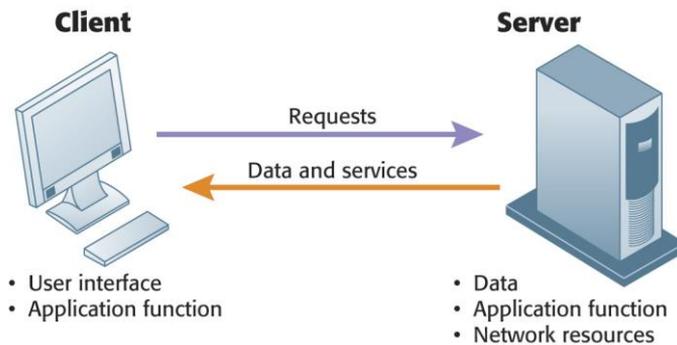


Figure 4-2

## IT Infrastructure: Computer Hardware

### 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
  - **Magnetic tape**
  - **Storage networking: SANs**
    - **Connect multiple storage devices on a separate high-speed network dedicated to storage**

## IT Infrastructure: Computer Hardware

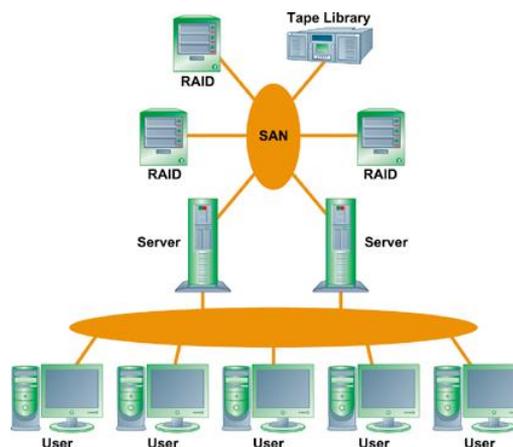
### A Storage Area Network (SAN)

SANs are an effort by corporations to **reduce storage costs, manage information, increase flexibility, and provide near-certain backup.**

One of the major worries of business firms is losing customer or other digital data.

Extraordinary efforts are taken to make redundant copies of digital information, and placing it on separate secure servers, even remote servers in separate facilities.

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.



## IT Infrastructure: Computer Hardware

### 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

## IT Infrastructure: Computer Hardware

### Storage, Input, and Output Technology

- **Output devices:**
  - Display data after they have been processed.
    - Monitor
    - Printer
    - Audio output
- **Information systems collect and process information in one of two ways.**
  - **Batch processing:** transactions stored for predefined amount of time, then processed as group
  - **Online processing:** transactions processed immediately

## IT Infrastructure: Computer Hardware

### Contemporary Hardware Trends

- **The emerging mobile digital platform**
  - Based on new handheld hardware like cell phones, netbooks, and tablet computers. A new “platform.”
  - Wireless communications through 3G cell networks and Wi-Fi.
  - New software apps.
- **Nanotechnology:** [video](#)
  - Uses individual atoms and molecules to create computer chips and other devices that are thousands of times smaller than current technologies permit.
  - Nanotechnology shrinks the size of transistors down to the width of several atoms.

## IT Infrastructure: Computer Hardware

### 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 ultrasmall electronic devices, and are very powerful conductors of electrical current.

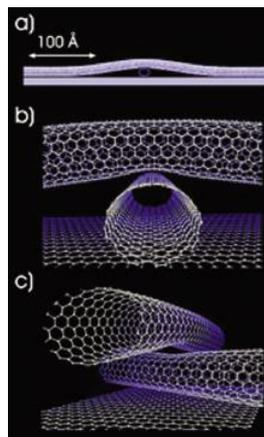


Figure 4-5

### IT Infrastructure: Computer Hardware Contemporary Hardware Trends

- **Cloud Computing:** [video](#)
  - A model of computing in which firms and individuals obtain computing resources over the Internet
    - Cloud infrastructure as a service
      - customers use processing, storage, networking, and other computing resources from cloud service providers to run their information systems.
    - Cloud platform as a service
      - customers use infrastructure and programming tools hosted by the service provider to develop their own applications.
    - Cloud software as a service
      - customers use software hosted by the vendor.
  - [Top Free Cloud Computing Software](#)

## Cloud Advantages

- Eliminates need for large up-front capital investments in systems
- Eliminates lengthy implementations on corporate computers
- Low cost subscriptions; no expensive licensing and maintenance fees
- No hardware for subscribers to purchase, scale, and maintain
- No operating systems, database servers or applications servers to install
- No consultants and staff
- Accessible via standard Web browser with behind-the-scene software updates
- Better scalability, eliminate cost and complexity of managing multiple layers of hardware and software

## Cloud Disadvantages

- May not be attractive to larger companies for their application needs
- Responsibility of data storage and control is in the hands of the provider
- Security risks may increase and open vulnerabilities to data maintenance
- System reliability issues
- Users dependency on the cloud computing provider

### IT Infrastructure: Computer Software

#### Cloud Computing Platform



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.

Figure 4-6

# Virtualization

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

## IT Infrastructure: Computer Hardware

### Contemporary Hardware Trends

- **Virtualization:** [video](#)
  - Process of presenting a set of computing resources so they can be accessed in ways that are unrestricted by physical configuration or geographic location
  - IBM's mainframes run tens of thousands of separate instances of Windows or Linux on a single large mainframe computer, giving users the impression they have their own dedicated computer
  - **Server virtualization:** running more than one operating system at the same time on single machine.
  - Virtual memory is memory which fools the processor into thinking it is hardware memory but in fact is memory located on a hard drive.

## IT Infrastructure: Computer Hardware

### Contemporary Hardware Trends

- **Multicore processors:**
  - Integrated circuit with two or more processors
  - Enhanced performance, reduced power consumption, and more efficient simultaneous processing of multiple tasks

## IT Infrastructure: Computer Software

### Operating System Software

- The software that manages and controls the computer's activities
- PC operating systems and graphical user interfaces
  - GUIs
  - Windows XP, Windows Vista, and Windows Server 2003
  - UNIX
  - Linux
    - Open-source software

## 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.

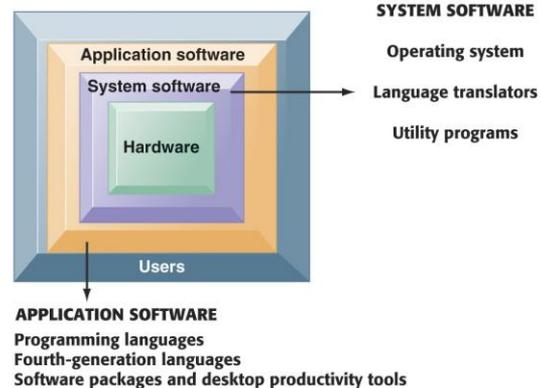


Figure 4-7

## IT Infrastructure: Computer Software

### Software for the Web: Java, AJAX, and HTML

- Java:
  - Operating system-independent, processor-independent, object-oriented programming language
- AJAX:
  - Allows a client and server to exchange data behind the scenes to avoid reloading a Web page after each change
- 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

## IT Infrastructure: Computer Software

**Web 2.0** [Video](#)

- **Web services:**
  - Software components that exchange information with one another using universal Web communication standards and languages
  - It's a "messaging system" which allows diverse computing applications in a firm to communicate data with one another without extensive integration of the constituent applications (which tends to be very expensive)
  - **XML (extensible markup language)**
    - **SOAP** (simple object access protocol)
    - **WSDL** (Web services description language)
    - **UDDI** (universal description, discovery, and integration)
  - **Service oriented architecture (SOA)**
    - In a service-oriented architecture, various applications provide "services" (data) on request to other applications needing data.
    - SOA is a major alternative to installing large scale enterprise systems.

## IT Infrastructure: Computer Software

**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.

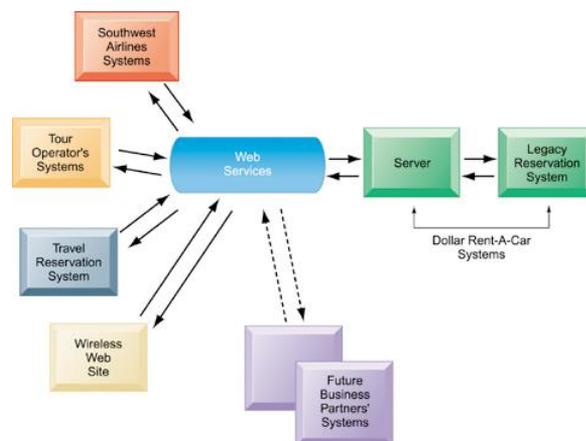


Figure 4-9

## IT Infrastructure: Computer Software

### Software Trends

- **Open Source Software**
  - Linux, Apache
- **Cloud Computing**
  - Google Apps, Office Web Apps

**Mashups** are Web applications that combine content or data from multiple online sources into new Web applications

- Contents are continually updated
- Content for mashups often comes from Web feeds and Web services
- Amazon uses mashup technologies to aggregate product descriptions with partner sites and user profiles, commentaries, and images.
- Travel sites, such as Travelocity, Kayak, Matador, and Travature, integrate standard content (such as airfare search engines, travel guides, maps, and hotel reviews) with comments, ratings, and images from users.
- **Software as a Service (SaaS)**
  - Salesforce.com

## 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
      - minimum response time for processing business transactions.
      - Throughput
- **Scalability:** ability of system to expand to serve large number of users without breaking down
  - Organizations must ensure they have sufficient computer processing, storage, and network resources to handle surging volumes of digital transactions and to make such data immediately available online.

### 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**
  - Five year TCO for computing equipment can be 3 – 10 times the original purchase price
  - TCO can be reduced through increased centralization, standardization of hardware and software resources.

### Components of TCO for a IT System

<b>Hardware acquisition</b>	Purchase price of hardware including computers, terminals, storage and printers
<b>Software acquisition</b>	Purchase or license of software for each user
<b>Installation</b>	Cost to install hardware and software
<b>Training</b>	Cost to train IT staff and end-users
<b>Support</b>	Cost to provide ongoing technical support; help desks, documentation etc
<b>Infrastructure</b>	Cost to acquire, maintain and support related infrastructure such as networks and specialized equipment (including storage and backup units)
<b>Downtime</b>	Lost productivity if hardware or software failures cause the system to unavailable for processing user tasks
<b>Space and energy</b>	Real estate and utility costs for housing and providing power for the technology

## Strategies for Creating and Deploying Software

- **Commercial off-the-shelf** software solutions are ready-made and available for licensing or sale to the general public
  - Off-the-shelf software systems that cannot be modified to meet the specific needs of a particular organization are sometimes called turn-key systems or software
- **Custom software development** describes how an organization develops and builds software tailored specifically to its needs.

## Strategies for Creating and Deploying Software continued

- **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)**
      - a formal contracts between customers and service providers that define the specific responsibilities of the service provider and the level of service expected by the customer.

## Advantages of Outsourcing

- Allows a business to concentrate on its core competencies rather than focusing on technology issues.
- Instead of purchasing all the necessary hardware and software for hosting a Web site, a business can use a Web hosting service that maintains a large Web server
- Outsourcing custom software development or maintenance to outside firms benefits a company because it won't have to hire programmers, analysts, and managers with the necessary skills.
- An outsourcer often has the technical and management skills to do the job better, faster, and more efficiently.
- Even though it's often cheaper to outsource the maintenance of an IT infrastructure and the development of new systems to external vendors, a business must weight the pros and cons carefully.

### 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
  - **Amazon Markets <http://www.amazonservices.com/>**
  - **Amazon provides cloud services to major business firms, and also to thousands of small merchants who want to use Amazon software to sell their goods and services.**
- **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**

### Managing Hardware and Software Technology

- **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 monetary structure
  - Differences in business processes
- All of these factors add to TCO of using technology service providers
- <http://www.ricintl.com> **Language Scientific**
  - firms are translating their systems and localizing them (which is more than just translation).