Chapter 5

IT Infrastructure and Emerging Technologies

Learning Objectives

5.1 Discuss IT infrastructure and its evolution.

5.2 Describe the components of IT infrastructure.

5.3 Discuss the mobile platform, apps, and BYOD.

5.4 Discuss quantum computing and green computing.

5.5 Discuss virtualization and cloud computing.

5.6 Describe contemporary software platforms.

5.7 Discuss alternative way of obtaining software.

5.8 Describe IT infrastructure for AI.

5.9 Discuss IT infrastructure management challenges.

5.8 Understand how the information in this chapter can help your career.

Video Cases

Case 1: Rockwell Automation Fuels the Oil and Gas Industry with the Internet of Things (IoT)

https://www.youtube.com/watch?v=eg8URrKkf7Y

Case 2: ESPN.com: The Future of Sports Broadcasting in the Cloud
https://www.youtube.com/watch?v=zv7q1Wx_QHw

Case 3: Netflix: Building a Business in the Cloud
https://www.youtube.com/watch?v=XrWII4ewrXA

Southeast Asia's Grab Leverages Information Technology to Enhance Its Services

- Problem

- Solutions
  - scalable services, GrabMaps
- Illustrates use of cloud computing to improve effectiveness and control costs.

5.1 Discuss IT infrastructure and its evolution?

Defining IT Infrastructure

$5.06 trillion industry in 2024

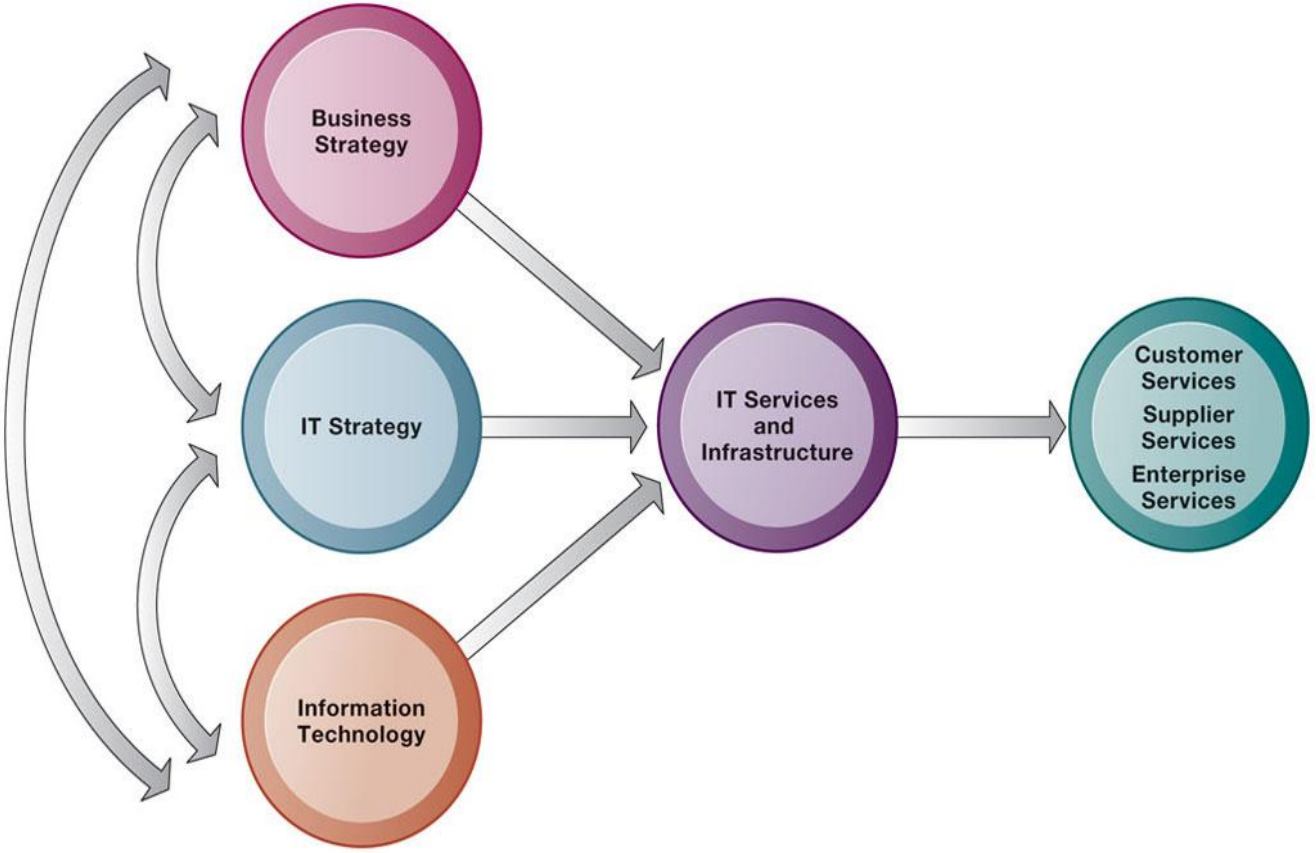
- Investments in infrastructure account for 25-50% of IT expenditures in large firms.

- **IT infrastructure:**
  - **Set of physical devices and software applications required to operate the entire enterprise**
  - **Set of firmwide services including:**
    - Computing platforms providing computing services
    - Telecommunications services
    - Data management services
    - Application software services: providing ERP, CRM, SCM, KMS
    - Physical facilities management services
    - IT management, standards, education, R&D, and other services
  - **"Service platform" perspective**
    - A more accurate view of (business) value of investments

It refers to analyzing the actual services enabled by new technology tools. For example, a new PC might save an employee one hour per day in wait time for information, dramatically increasing his/her value to the firm.

Figure 5.1 Connection Between the Firm, IT Infrastructure, and Business Capabilities

The point of this slide is to illustrate the centrality of IT infrastructure and services to the achievement of firm success. Ultimately, what the firm delivers to customers, its quality, is a direct function of the power of its infrastructure. e.g.) Amazon is routinely cited as the most popular online shopping site and receives high praise from customers for the quality of its service and speed of execution. There is a reason for this: Amazon has one of the world's largest computing infrastructures numbering several hundred thousand processors to provide these services.

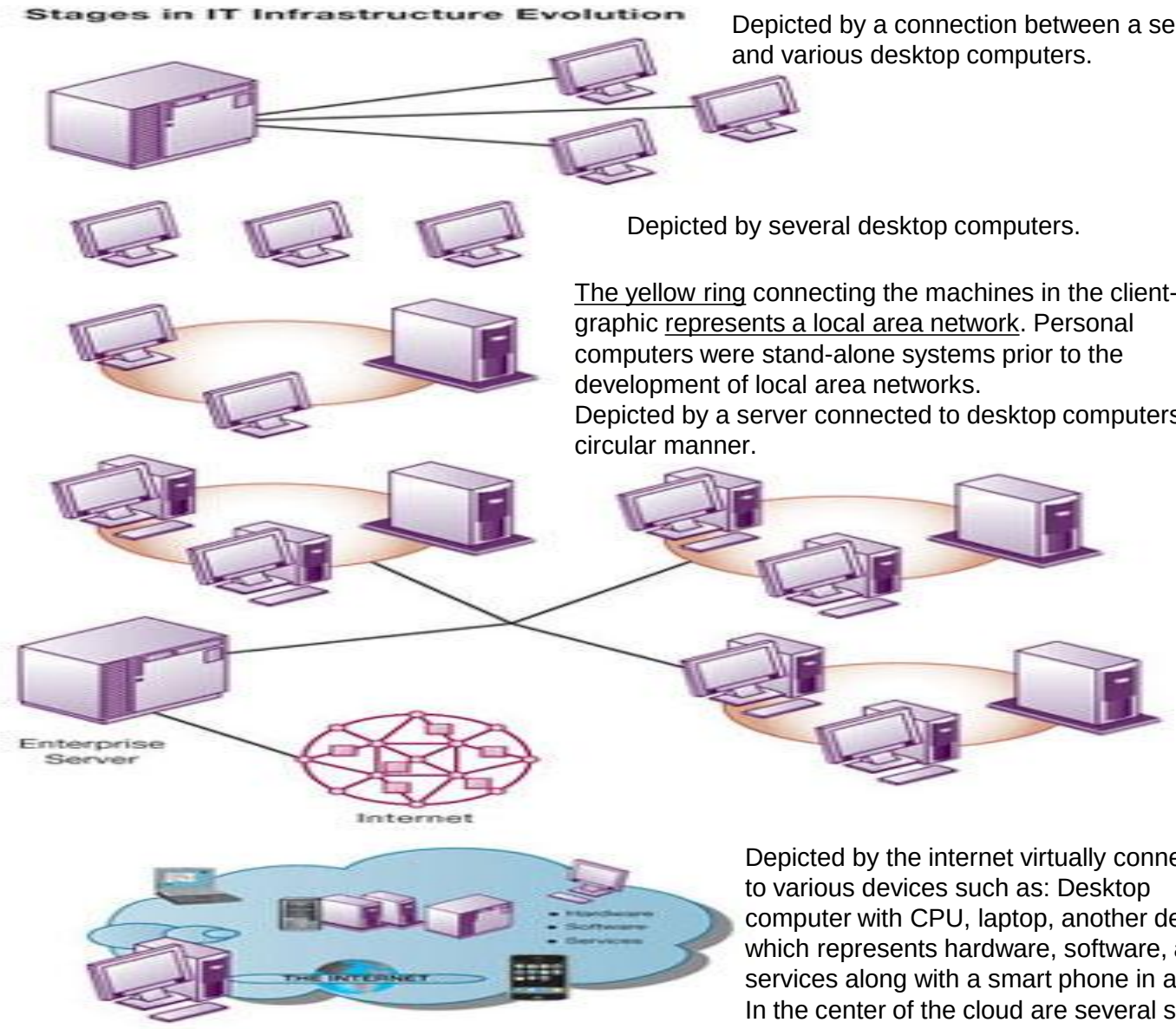


The services a firm is capable of providing to its customers, suppliers, and employees are a direct function of its IT infrastructure. Ideally, this infrastructure should support the firm's business and information systems strategy. New information technologies have a powerful impact on business and IT strategies, as well as the services that can be provided to customers.

Evolution of IT Infrastructure

- Mainframe and minicomputer era: 1959 to present
- Personal computer era: 1981 to present
- Client/server era: 1983 to present
- Enterprise computing era: 1992 to present
- Cloud and mobile computing: 2000 to present

Figure 5.2 Stages in IT Infrastructure Evolution



Depicted by a connection between a server and various desktop computers.

Depicted by several desktop computers.

The yellow ring connecting the machines in the client-server graphic represents a local area network. Personal computers were stand-alone systems prior to the development of local area networks.
Depicted by a server connected to desktop computers in a circular manner.

Depicted by network of various servers connected to several desktop computers with CPU in a circular manner to one enterprise server. The enterprise server is connected to the internet.

Depicted by the internet virtually connected to various devices such as: Desktop computer with CPU, laptop, another desktop which represents hardware, software, and services along with a smart phone in a cloud. In the center of the cloud are several servers, including the enterprise server.

IT Infrastructure

The concept of mainframe computers: Think the difference in size (much larger) and computing capacity (much smaller) from today's computers to get a sense of perspective regarding how far the computing industry has gone in 70 years. However, modern-day mainframes (IBM z-Series), are extremely powerful servers used for large Fortune 1000 enterprise networks and corporate Web sites. The mainframe is not dead, in other words and still represents a large revenue stream for IBM.

- **Evolution of IT infrastructure**

  *** effects**

  - **General-purpose mainframe and minicomputer era: 1959 to present**
    - 1958: IBM first mainframes introduced
    - 1965: Less expensive DEC minicomputers introduced * IBM 360 series
  - **Personal computer era: 1981 to present**
    - 1981: Introduction of IBM PC * Wintel PC
    - Proliferation in 80s, 90s resulted in growth of personal software
  - **Client/server era: 1983 to present**
    - Desktop clients networked to servers, with processing work split between clients and servers
    - Network may be two-tiered or multitiered (N-tiered)
    - Various types of servers (network, application, Web)

- **Evolution of IT infrastructure (cont.)**
  - **Enterprise computing era: 1992 to present**
    - Move toward integrating disparate networks, applications using Internet standards and enterprise applications

TCP/IP

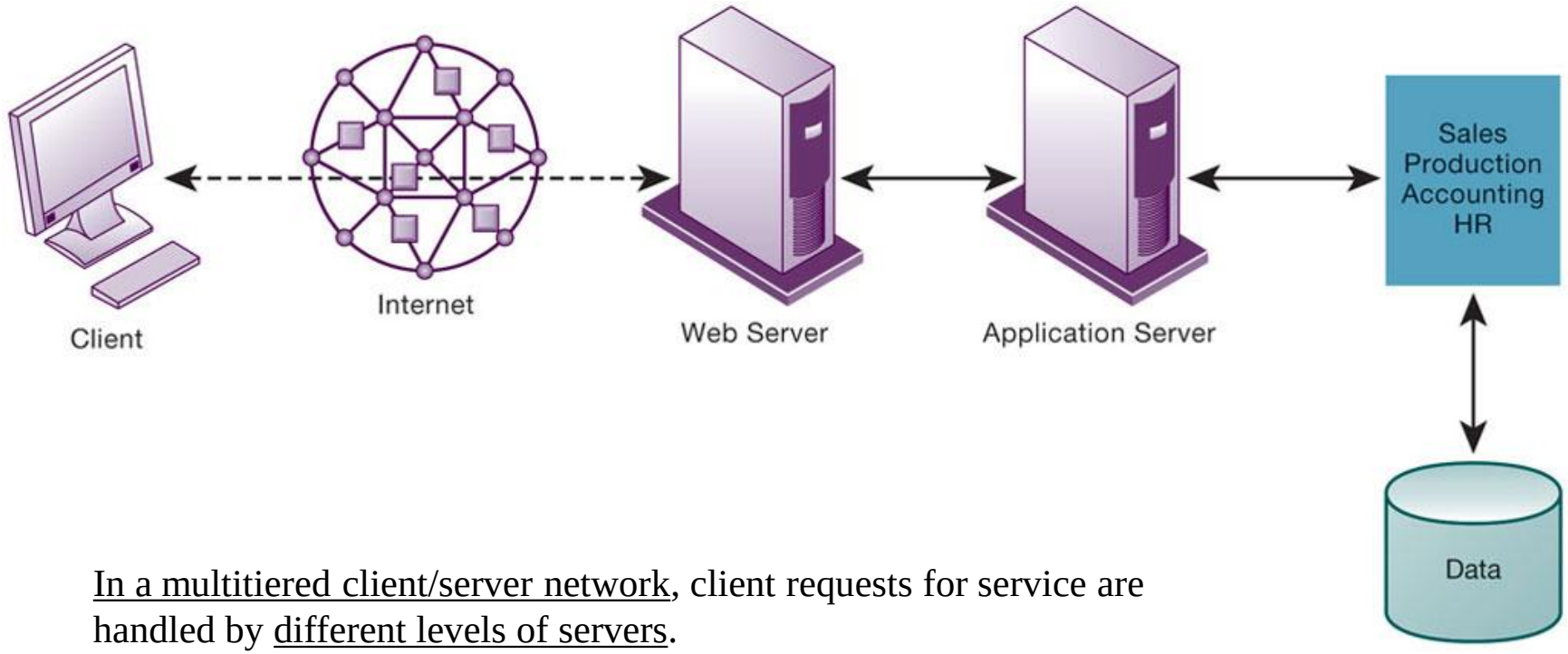
-> information can flow freely across the org. and between the firm and other org.

  - **Cloud and mobile computing: 2000 to present**
    - Cloud computing: computing power and software applications supplied over the Internet or other network
      - Fastest growing form of computing

Driver: the growing bandwidth power of the Internet

- Examples of the use of cloud computing are Google Apps, Google's suite of software applications that rivals Microsoft's Office applications at a fraction of the cost, and Salesforce.com's CRM management software, delivered over the Internet. Most large Fortune 500 firms have some applications that run in the cloud.
- Most of these same corporations do not put their strategic or critical systems on the cloud just yet because of lingering concerns about reliability and security.

Figure 5.3 A Multitiered (N-Tier) Client/Server Network



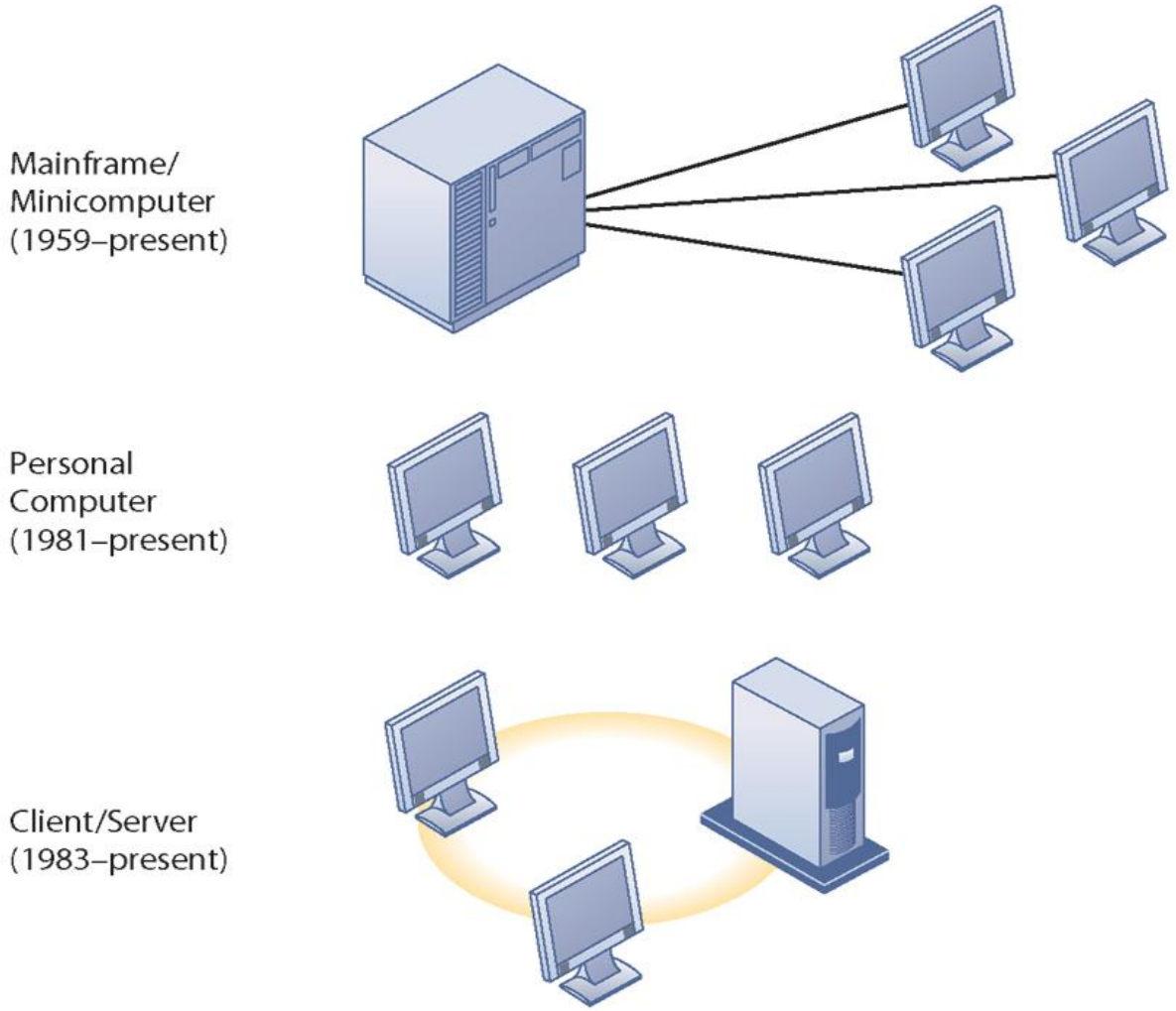
In a multitiered client/server network, client requests for service are handled by different levels of servers.

- The distribution of computing power across smaller, less expensive machines enabled by client/server computing is in part responsible for the drastic increase in computing power and applications throughout the firm.
- Prior to small, less expensive server computers, computing power had to purchased in large blocks at great expense. With client/server computing, you can grow your firm's inventory of computers gradually, over time, to meet current demand.

STAGES IN IT INFRASTRUCTURE EVOLUTION

Illustrated here are the typical computing configurations characterizing each of the five eras of IT infrastructure evolution.

FIGURE 5-2

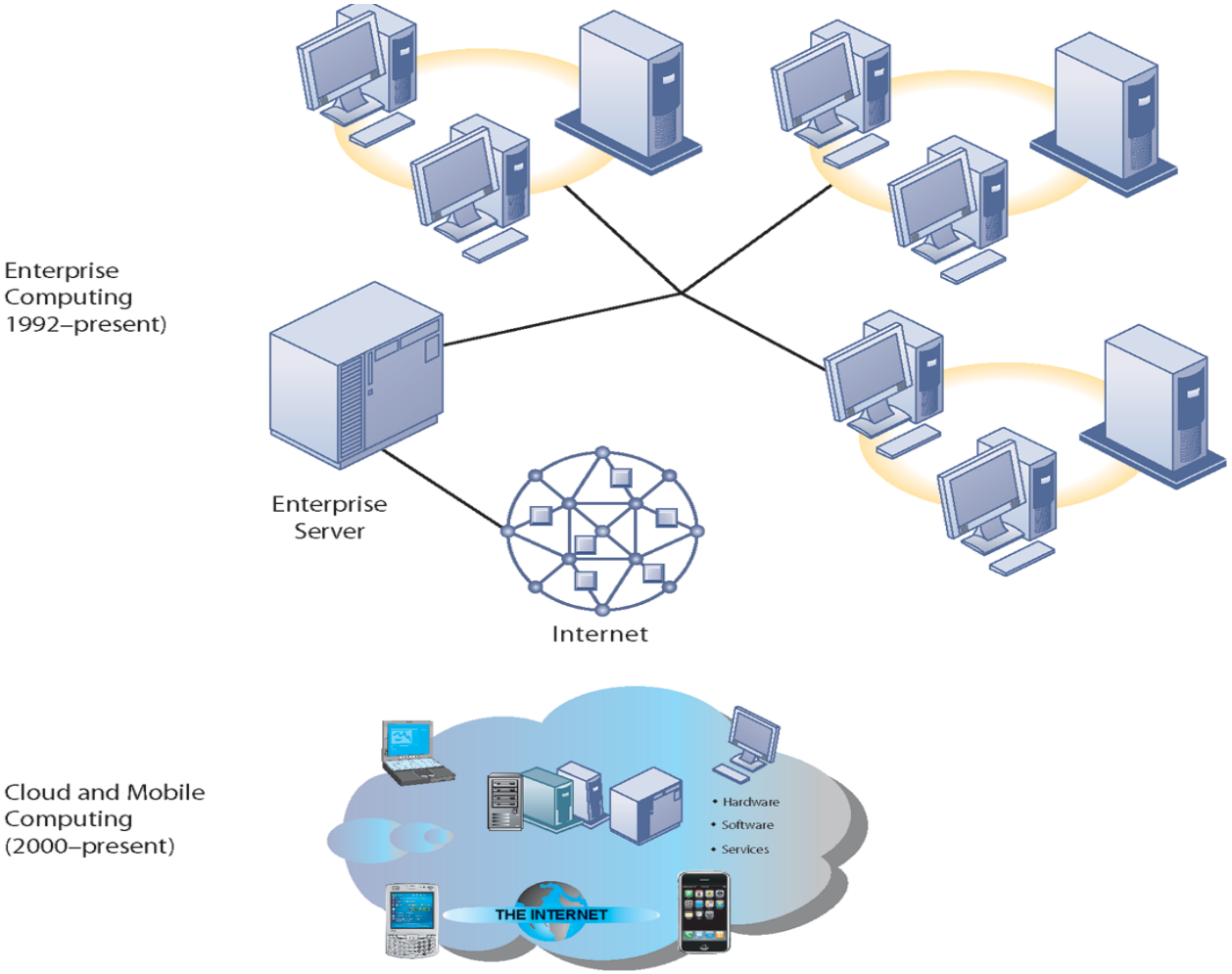


* The yellow ring connecting the machines in the client-server graphic represents a local area network (LAN). Personal computers were stand-alone systems prior to the development of local area networks (LANs).

STAGES IN IT INFRASTRUCTURE EVOLUTION (cont.)

FIGURE 5-2

The enterprise Internet graphic represents several individual networks linked together into an enterprise-wide network. The cloud computing graph represents several types of technology that are capable of connecting to the Internet and accessing applications and services through a cloud.

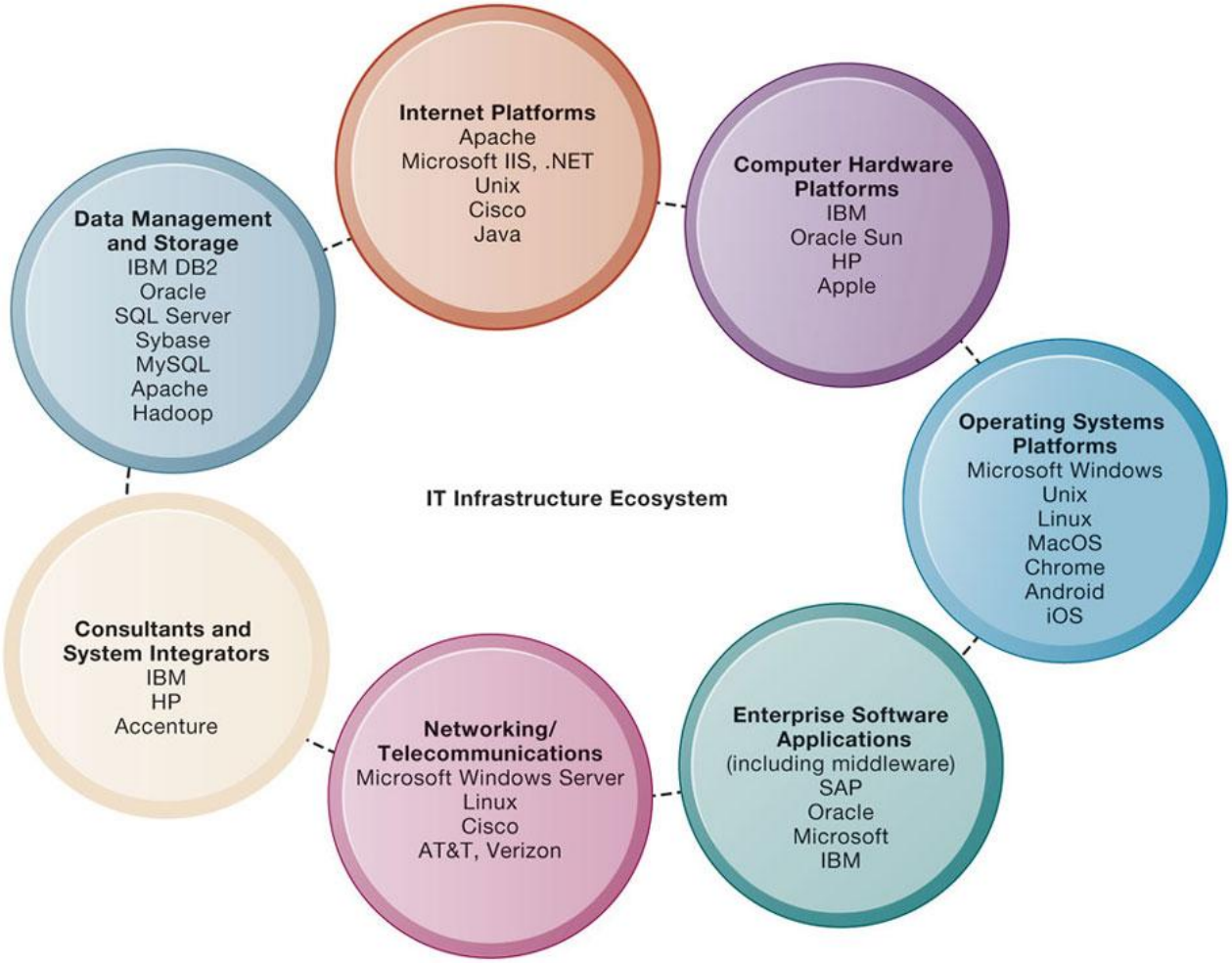


5.2 Describe the Components of IT Infrastructure? seven main components

1. Computer hardware platforms
2. Operating system platforms
3. Enterprise software applications
4. Data management and storage
5. Networking/telecommunications platforms
6. Internet platforms
7. Consulting system integration services

Figure 5.4 IT Infrastructure Components

There are seven major components that must be coordinated to provide the firm with a coherent IT infrastructure. Listed here are major technologies and suppliers for each component.



Take a look at the example companies that appear under each heading. What companies appear repeatedly? How many items are unfamiliar?

Computer Hardware Platforms

- Client machines
  - Desktop PCs, laptops
  - Mobile computing: smartphones, tablets (worldwide, over 7 billion people use smartphones)
  - Desktop chips vs. mobile chips NVIDIA
- Mainframes
  - IBM mainframe (equivalent to thousands of blade servers)
  - Digital workhorse for banking and telecommunications networks
  - Mainframes have not disappeared

To think the size of the market for computer hardware and devices, in 2020, firms worldwide will spend around $688 billion on computer hardware, from mainframes to tablets and smartphones.

Operating System Platforms

- The system S/W that manages and controls the activities of a computer-> over 68% of desktop and tablets use some form of the Microsoft Windows OS Chrome OS, Android, iOS (features a multitouch interface)
- Corporate servers
  - Windows Server
  - Unix
  - Linux: 90% of the world's cloud computing infra. runs on Linux
- Client level
  - Microsoft Windows
  - Android, iOS, Windows 10 (mobile/multitouch)
  - Google's Chrome OS (cloud computing)

Enterprise Software Applications

- In 2020, firms are expected to spend over $500 billion on software for enterprise applications
- Largest providers: SAP and Oracle
- Middleware providers: IBM, Oracle

- These applications are considered to be part of IT infrastructure. Traditionally, large firms were the most prominent users of enterprise software, but firms such as Microsoft have moved into the market of small- and medium-size businesses that can benefit from enterprise software.

Data Management and Storage

- Database software providers
  - IBM (Db2)
  - Oracle
  - Microsoft (SQL Server)
  - SAP (HANA)
  - My SQL
  - Apache Hadoop: is an open source S/W framework for managing very large data sets

The amount of new information in the world is doubling every three years, driving the need for more efficient data management and storage.

Networking/Telecommunications Platforms

- Network operating system software
  - Windows Server, Linux, Unix
- Network eqipment providers
  - Huawei, Nokia, Ericsson, Cisco Systems
- Telecommunication services
  - Telecommunications/telephone services companies that offer voice and data connectivity, WAN, wireless services and Internet access
  - AT&T, Verizon

Companies worldwide are expected to spend $1.5 trillion for telecommunications services in 2020.

Internet Platforms

- Hardware, software, and services to support company websites, intranets
  - Web-hosting services
  - Routers
  - Cabling or wireless equipment
- Internet hardware server market (has become concentrated in the hands of)
  - Dell, Cisco, HPE, IBM, and Oracle
- Web and app SW application development tools/suites
  - Microsoft (Visual Studio and Microsoft .NET development platform), Oracle, and a host of independent software developers

Consulting and System Integration Services

- Even large firms do not have resources for full range of support for new, complex infrastructure
- Leading consulting firms: Accenture, IBM Global Services, HPE, Infosys, and Wipro
- Software integration: ensuring new infrastructure works with legacy systems
- Legacy systems: an older system (TPS created for mainframes) that continues to be used to avoid the high cost of replacing or redesigning it
- Another big change: companies are moving more of their IT infrastructure to the cloud or to outside services