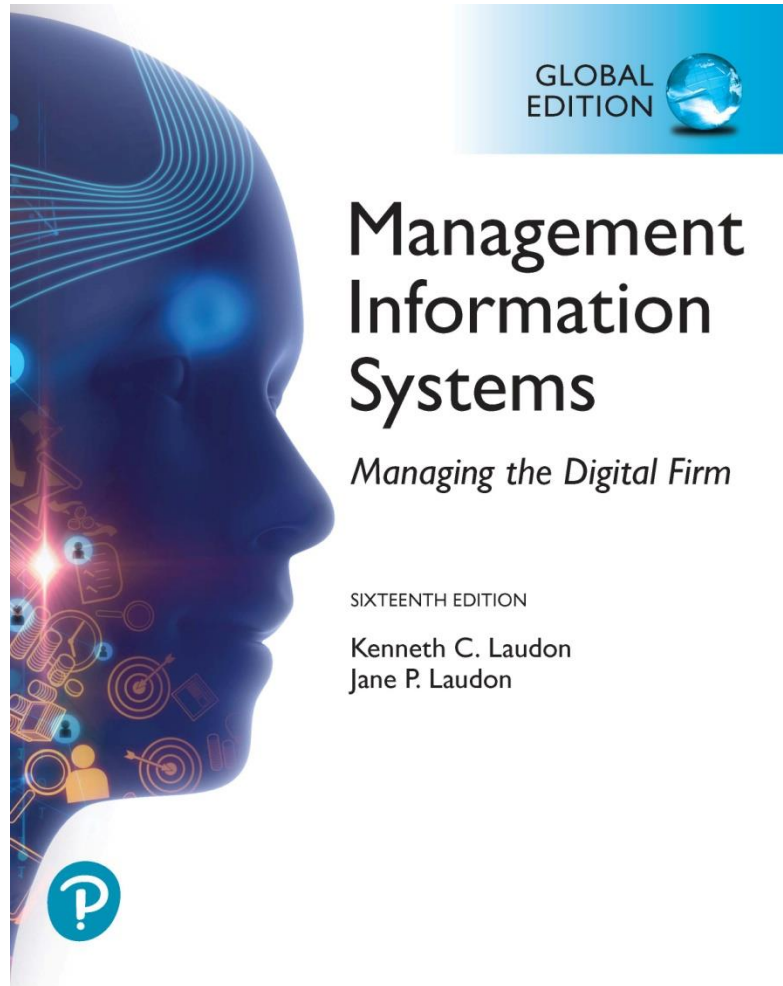


# Management Information Systems: Managing the Digital Firm

Sixteenth Edition • Global Edition



## Chapter 5

IT Infrastructure and Emerging  
Technologies

# Learning Objectives

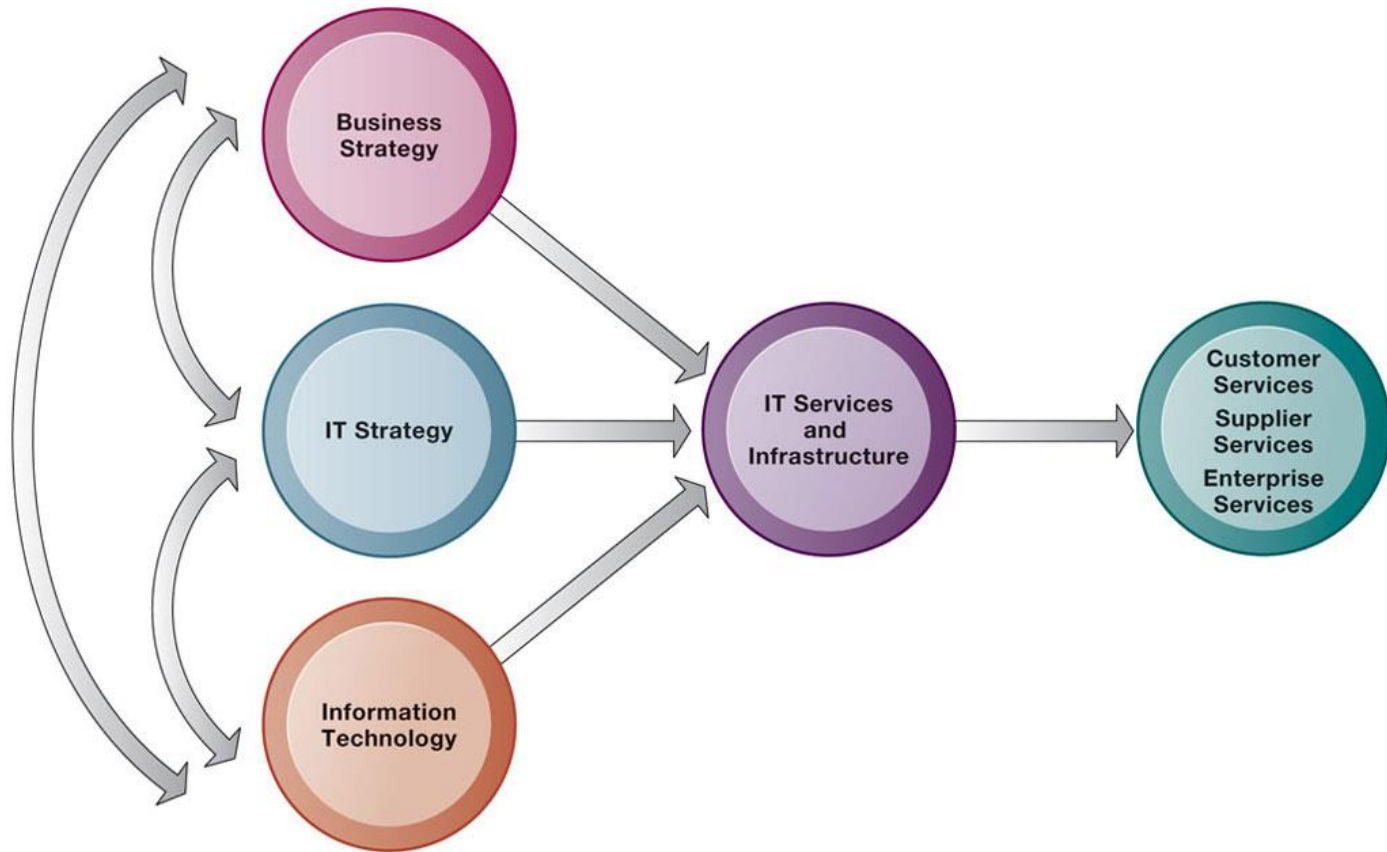
- 5.1** What is IT infrastructure, and what are the stages and drivers of IT infrastructure evolution?
- 5.2** What are the components of IT infrastructure?
- 5.3** What are the current trends in computer hardware platforms?
- 5.4** What are the current computer software platforms and trends?
- 5.5** What are the challenges of managing IT infrastructure and management solutions?
- 5.6** How will MIS help my career?

# Defining IT Infrastructure

- Set of physical devices and software required to operate an enterprise
- Set of firm-wide services including:
  - Computing platforms providing computing services
  - Physical facilities management services
  - IT management, education, and other services
- “Service platform” perspective
  - More accurate view of value of investments

## Figure 5.1

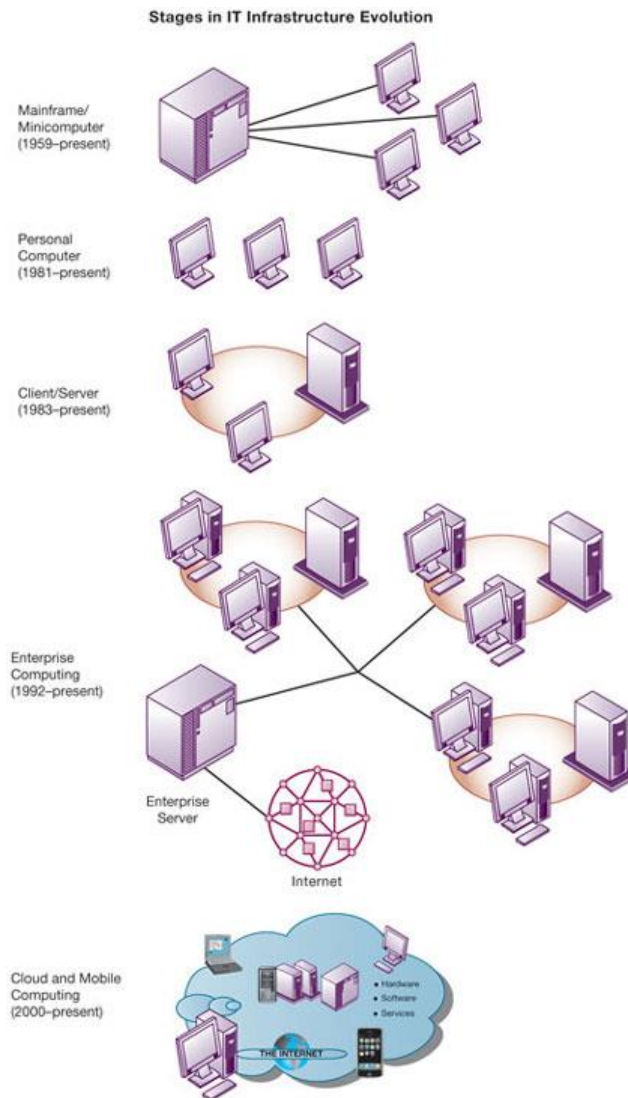
### Connection Between the Firm, IT Infrastructure, and Business Capabilities



# Evolution of IT Infrastructure

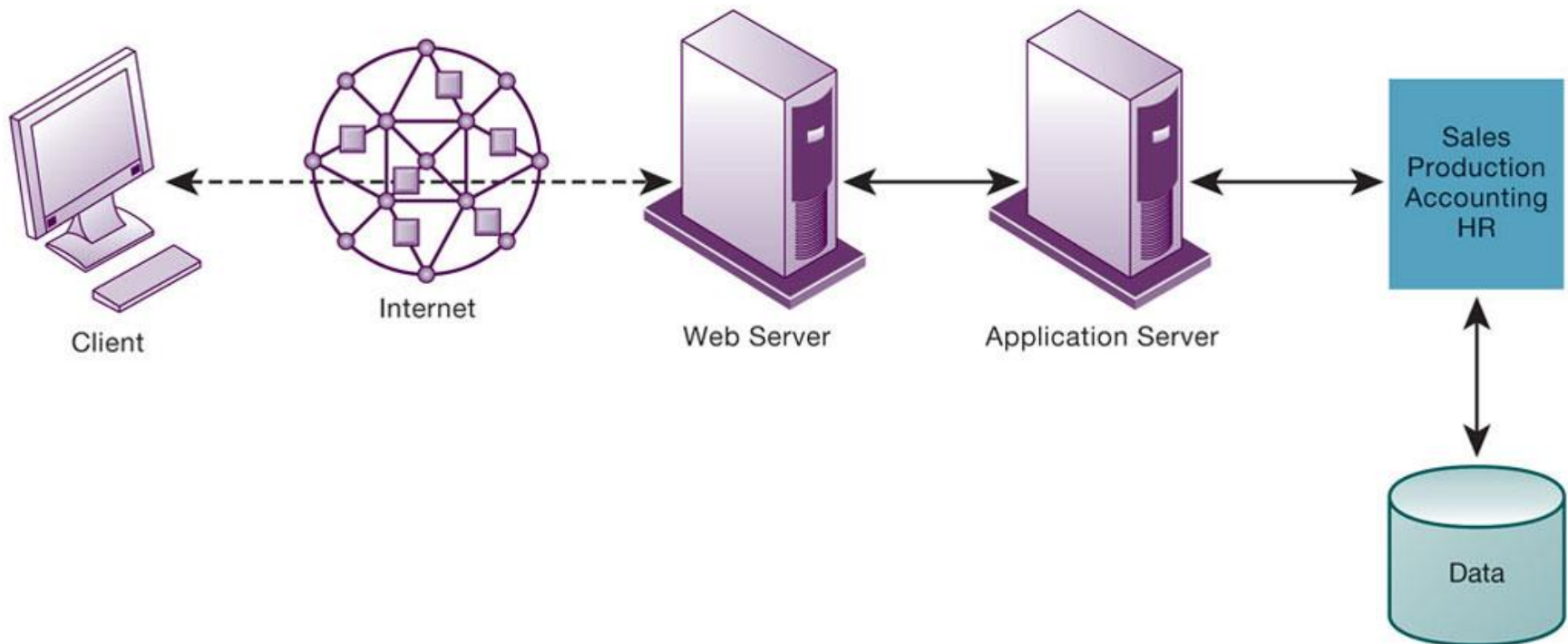
- General-purpose mainframe and minicomputer era → 1959 to present
- Personal computer era → 1981 to present
- Client/server era → 1983 to present
- Enterprise computing era → 1992 to present
- Cloud and mobile computing → 2000 to present

# Figure 5.2 Stages in IT Infrastructure Evolution



## Figure 5.3

# A Multi-tiered (N-Tier) Client/Server Network



# Technology Drivers of Infrastructure Evolution

(1 of 2)

- Moore's law and microprocessing power
  - Computing power doubles every 2 years
  - Nanotechnology
- Law of Mass Digital Storage
  - The amount of data being stored each year doubles
- Metcalfe's Law and network economics
  - Value or power of a network grows exponentially as a function of the number of network members.



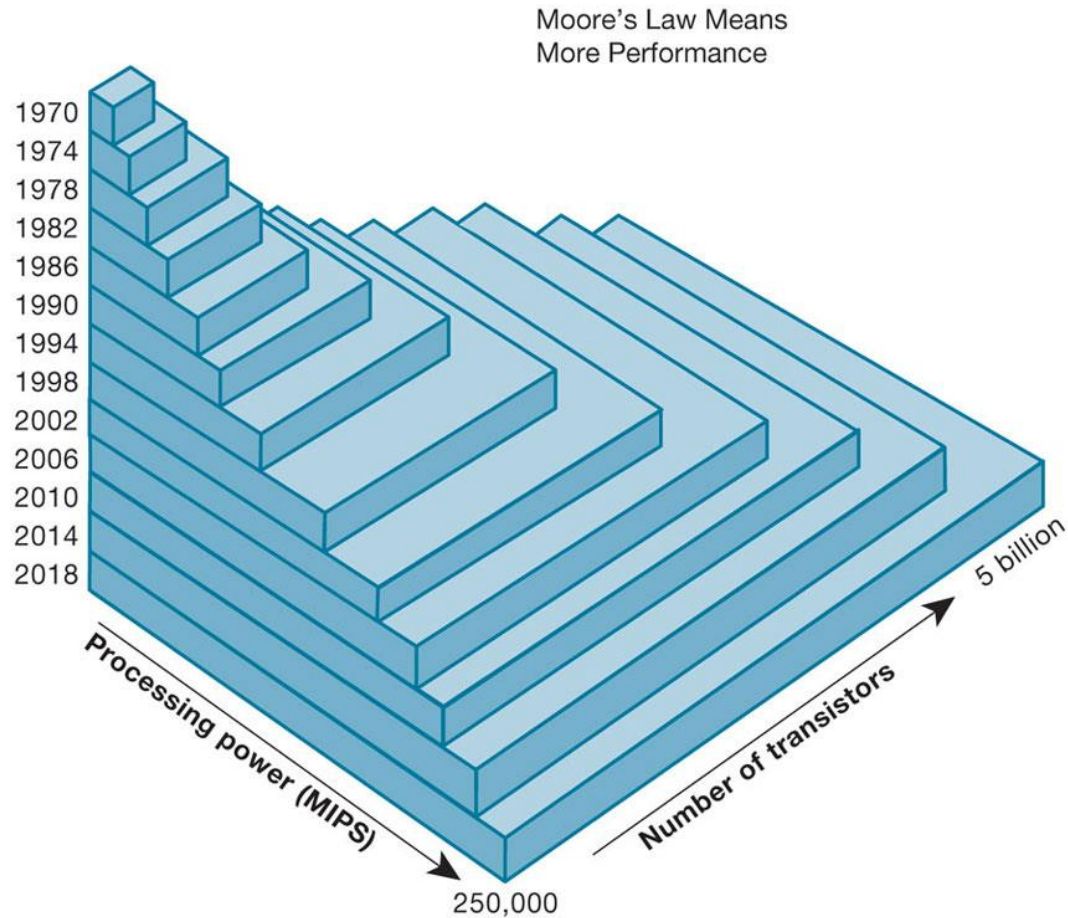
# Technology Drivers of Infrastructure Evolution

## (2 of 2)

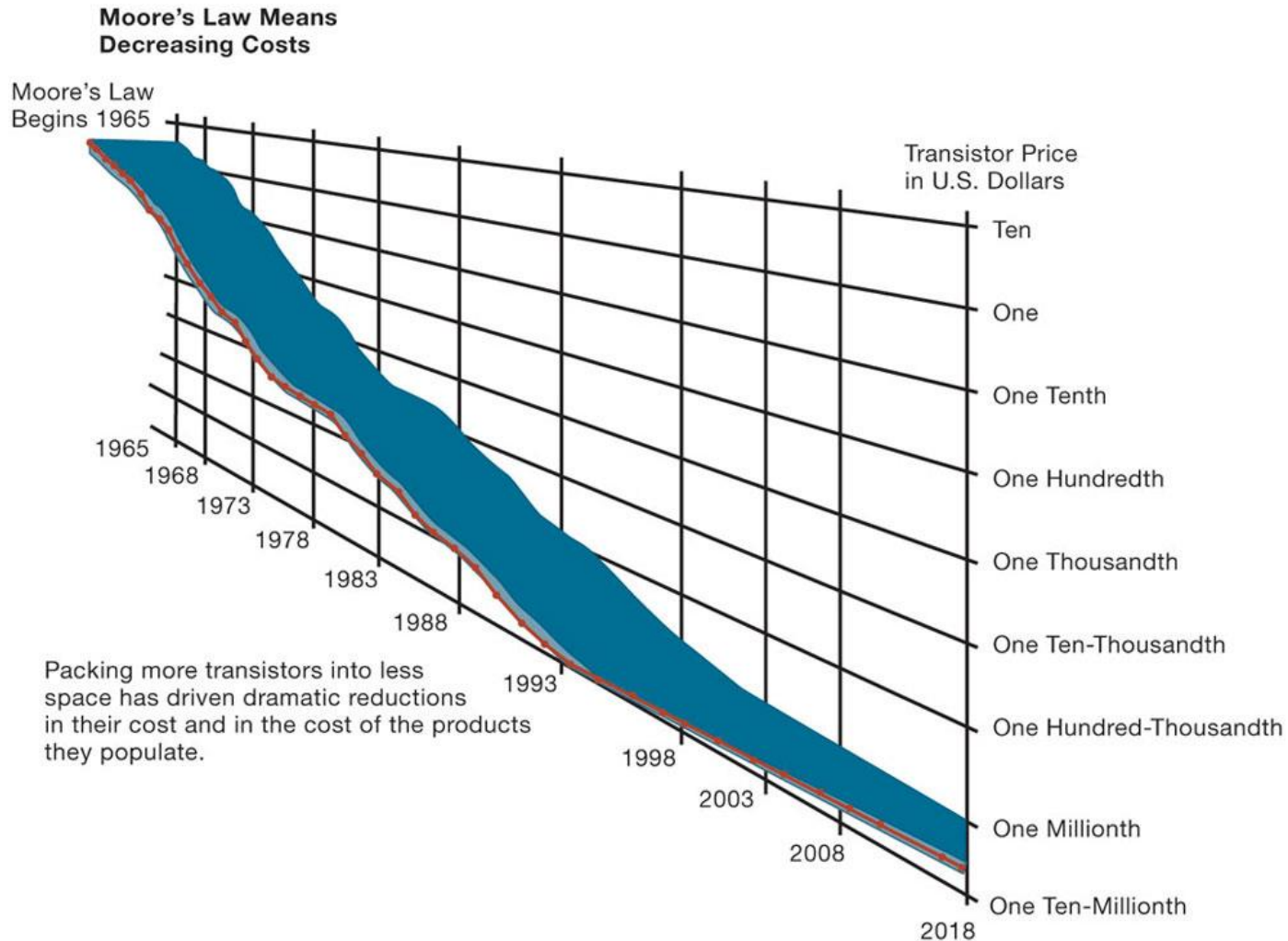
- Declining communication costs and the Internet
  - Exponential growth in size of the Internet
- Standards and network effects
  - Technology standards
    - Specifications that establish the compatibility of products and the ability to communicate in a network
    - Unleash powerful economies of scale and result in price declines

## Figure 5.4

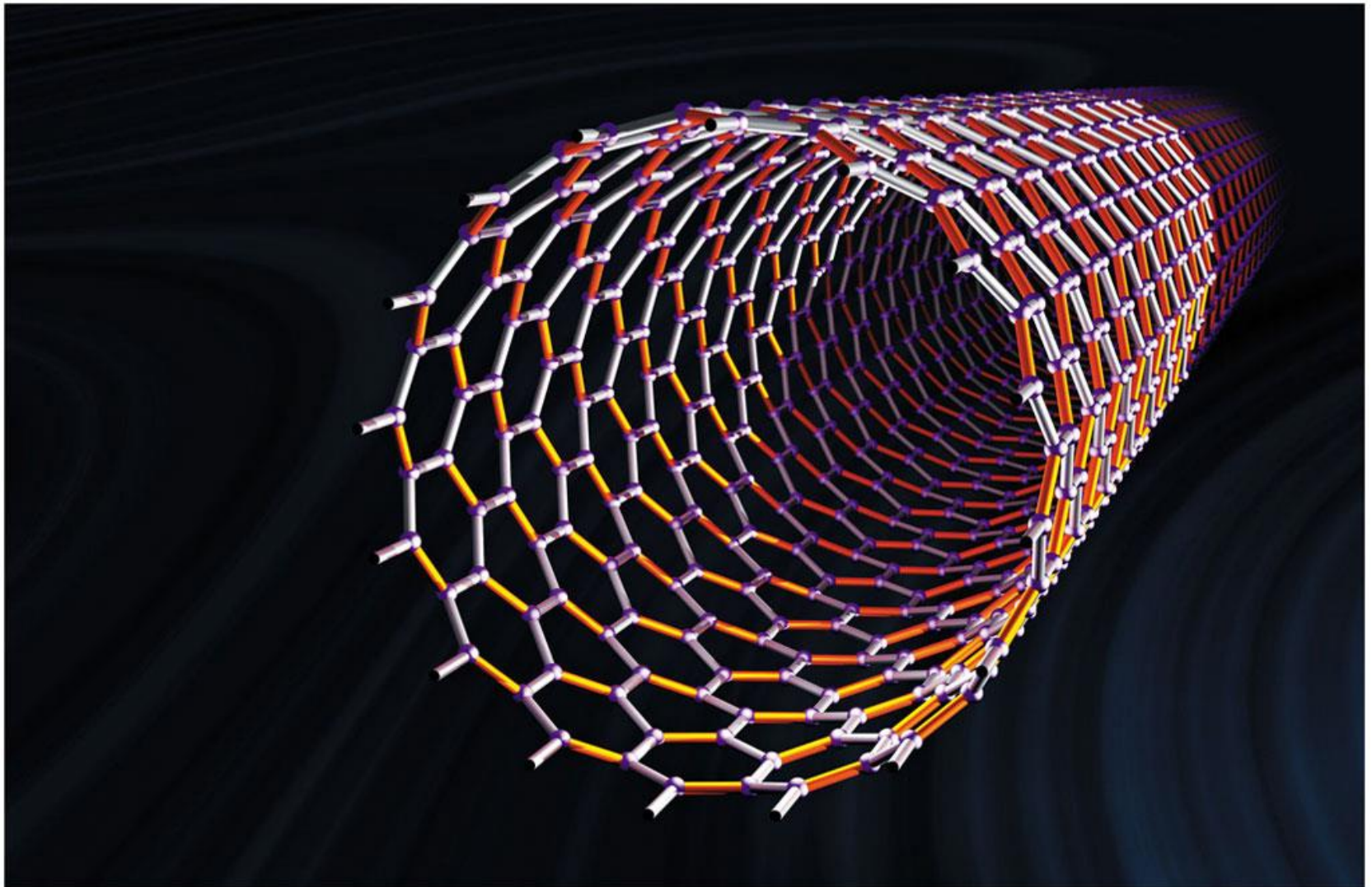
# Moore's Law and Microprocessor Performance



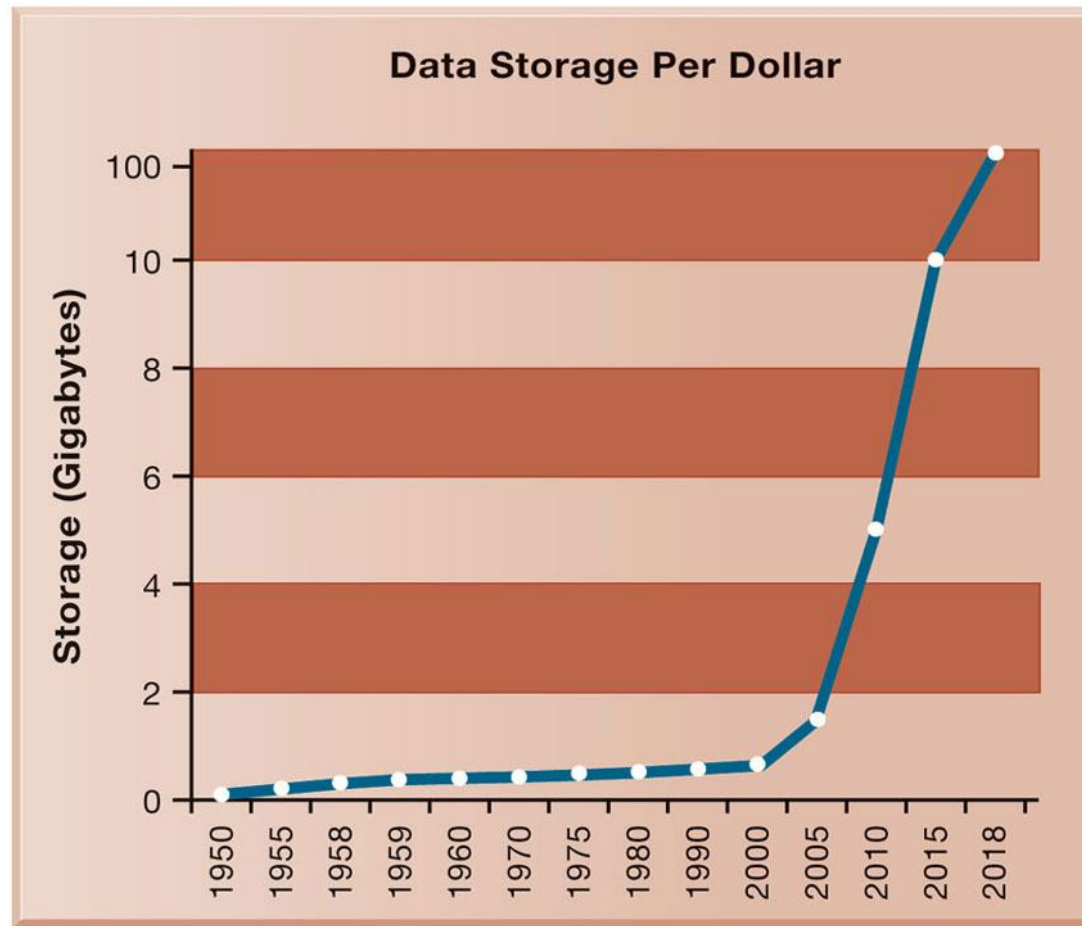
# Figure 5.5 Falling Cost of Chips



# Nanotubes

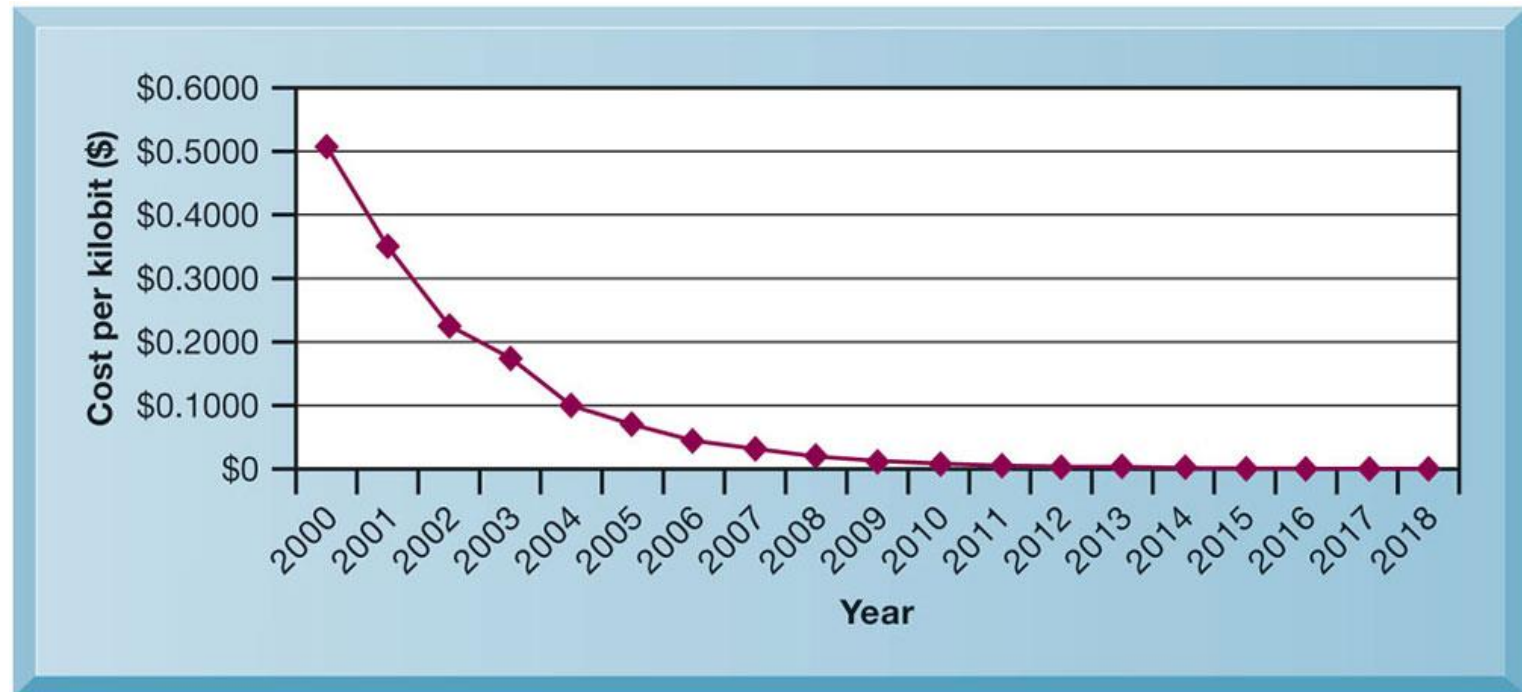


## Figure 5.6 The Amount of Storage Per Dollar Rises Exponentially, 1950–2016





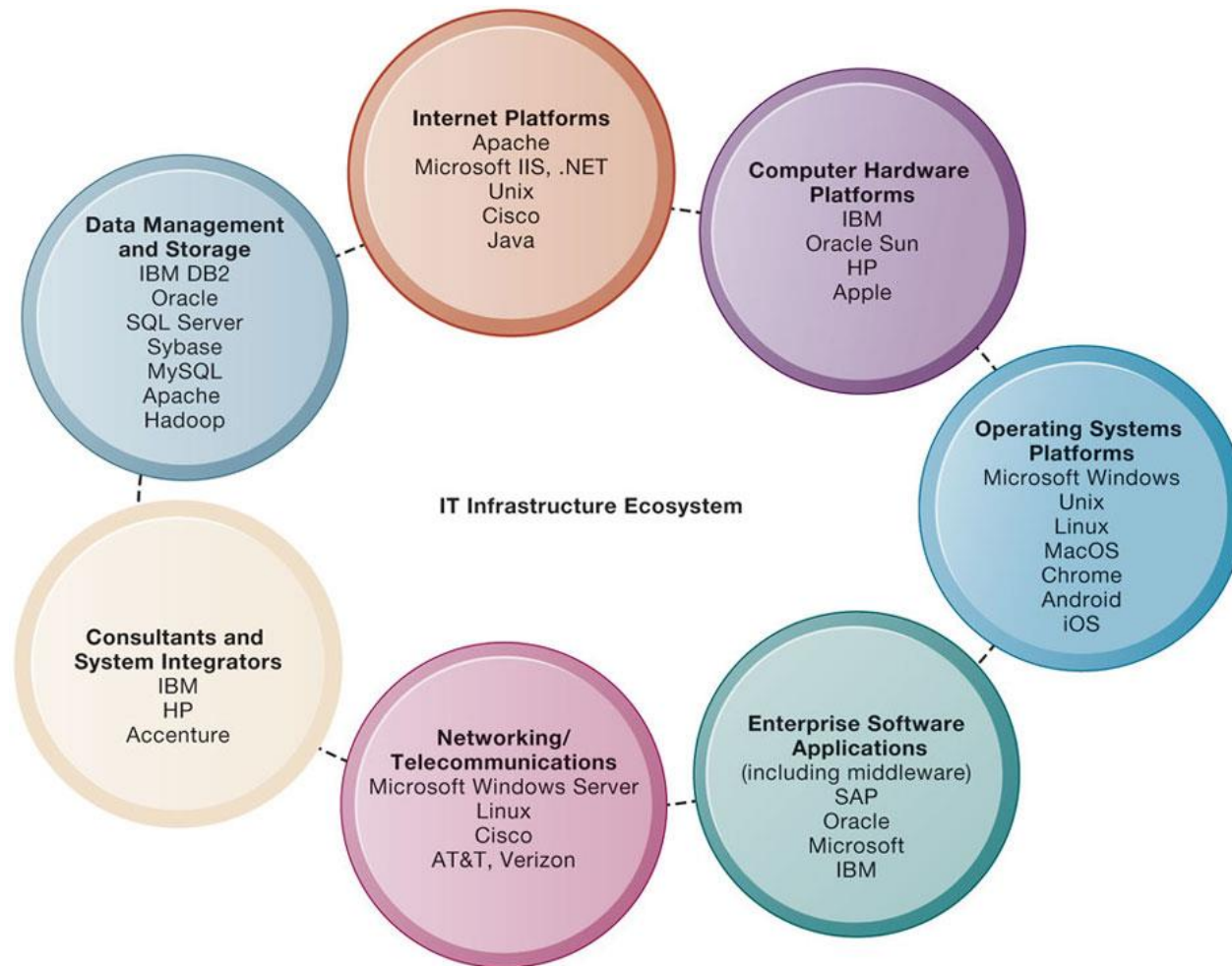
## Figure 5.7 Exponential Declines in Internet Communications Costs (\$/MBPS)



# What Are the Components of IT Infrastructure?

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 5.8 The IT Infrastructure Ecosystem





# Computer Hardware Platforms

- Client machines
  - Desktop PCs, laptops
  - Mobile computing: smartphones, tablets
  - Desktop chips vs. mobile chips
- Servers
- Mainframes
  - IBM mainframe
  - Digital workhorse for banking and telecommunications networks

# Operating System Platforms

- Corporate servers
  - Windows Server
  - Unix
  - Linux
- Client level
  - Microsoft Windows
  - Android, iOS, Windows 10 (mobile/multitouch)
  - Google's Chrome OS (cloud computing)

# Enterprise Software Applications

- In 2018, firms spend \$389 billion on software for enterprise applications
- Largest providers: SAP and Oracle
- Middleware providers: IBM, Oracle

# Data Management and Storage

- Database software providers
  - IBM (DB2)
  - Oracle
  - Microsoft (SQL Server)
  - Sybase (Adaptive Server Enterprise),
  - My SQL
  - Apache Hadoop
- Physical data storage for large-scale systems
  - Dell EMC
  - Hewlett Packard Enterprise (H3C)

# Networking/Telecommunications Platforms

- Network operating systems
  - Windows Server, Linux, Unix
- Network hardware providers
  - Cisco, Juniper Networks
- Telecommunication services
  - Telecommunications, cable, telephone company charges for voice lines and Internet access
  - AT&T, Verizon

# Internet Platforms

- Hardware, software, management services to support company websites, intranets
  - Web-hosting services
  - Routers
  - Cabling or wireless equipment
- Internet hardware server market
  - IBM, Dell, Oracle, HP
- Web development tools/suites
  - Microsoft (Visual Studio and .NET), Oracle-Sun (Java), Adobe

# 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, HP, Infosys, Wipro Technologies
- **Software integration:** ensuring new infrastructure works with legacy systems
- **Legacy systems:** older TPS created for mainframes that would be too costly to replace or redesign

# What Are the Current Trends in Computer Hardware Platforms? (1 of 5)

- The mobile digital platform
  - Smartphones
  - Netbooks
  - Tablet computers
  - Digital e-book readers and apps (Kindle)
  - Wearable devices
- Consumerization of IT and BYOD (bring your own device)
  - Forces businesses and IT departments to rethink how IT equipment and services are acquired and managed



# What Are the Current Trends in Computer Hardware Platforms? (2 of 5)

- Quantum computing
  - Uses quantum physics to represent and operate on data
  - Dramatic increases in computing speed
- Virtualization
  - Allows single physical resource to act as multiple resources (i.e., run multiple instances of OS)
  - Reduces hardware and power expenditures
  - Facilitates hardware centralization
  - Software-defined storage (SDS)

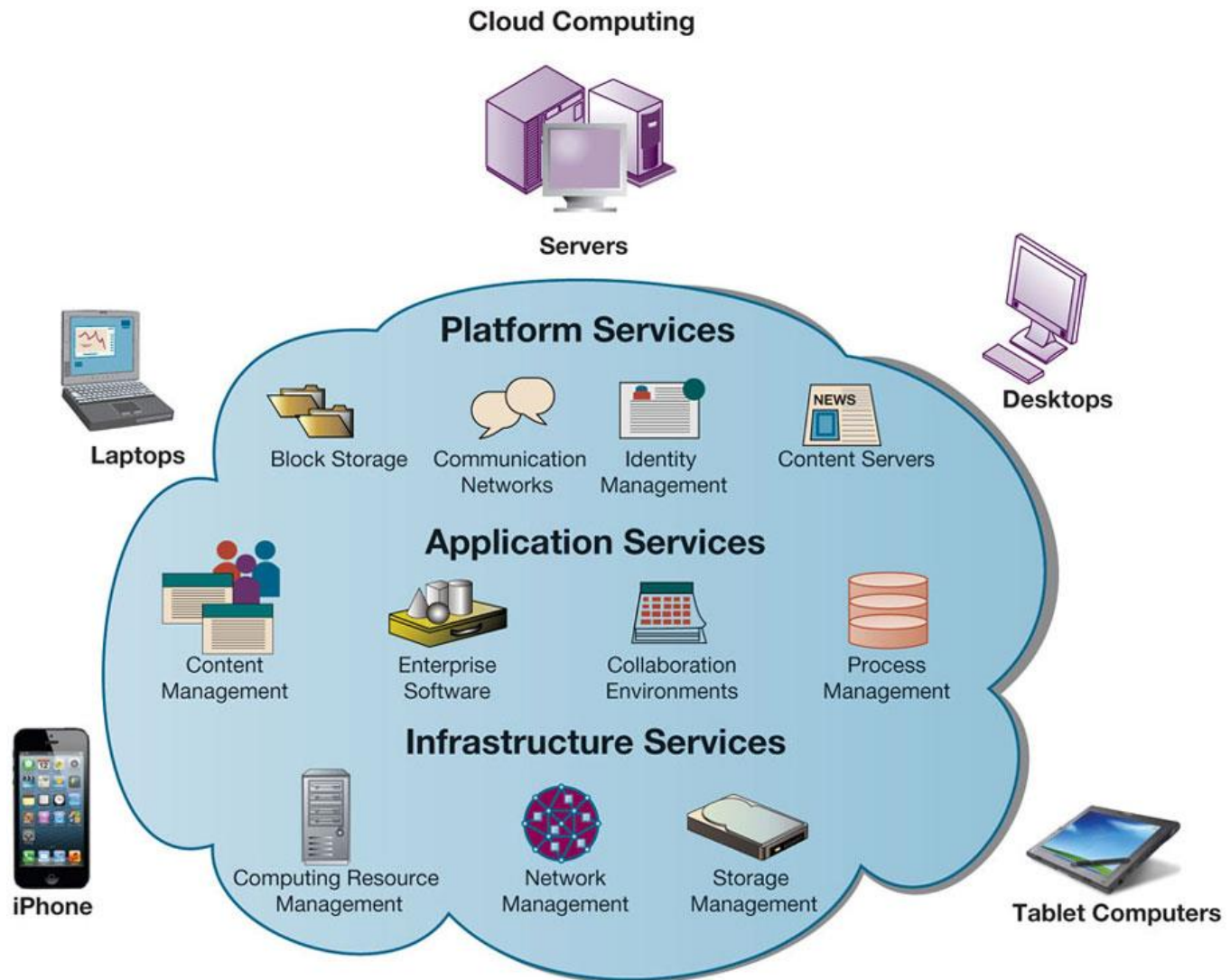
# What Are the Current Trends in Computer Hardware Platforms? (3 of 5)

- Cloud computing
  - On-demand computing services obtained over network
    - Infrastructure as a service (IaaS)
    - Software as a service (SaaS)
    - Platform as a service (PaaS)
  - Cloud can be public or private
  - Allows companies to minimize IT investments
  - Drawbacks: Concerns of security, reliability
  - Hybrid cloud computing model

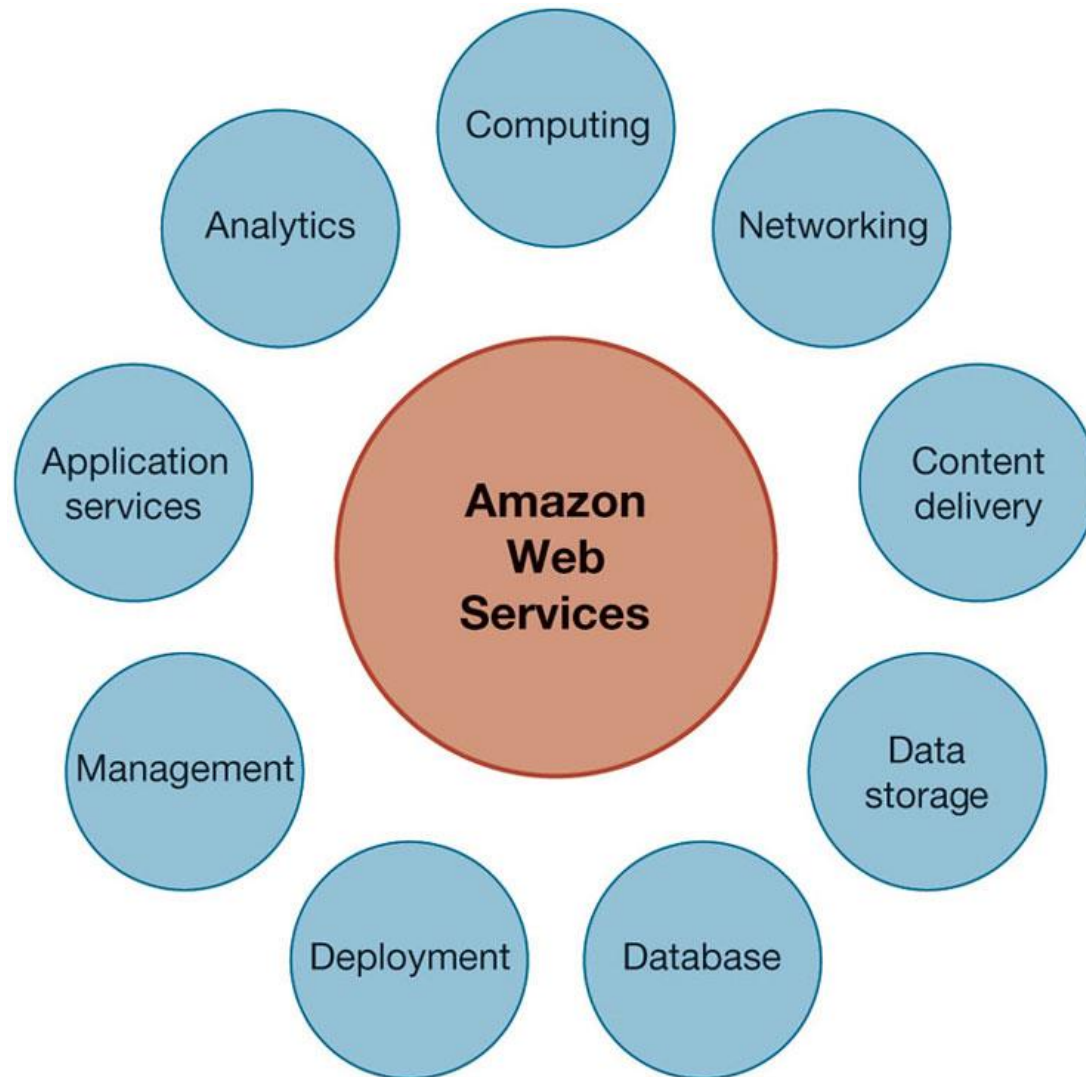
# What Are the Current Trends in Computer Hardware Platforms? (4 of 5)

- Edge computing
  - Servers at the edge of the Internet
  - Reducing latency, and network traffic

# Figure 5.9 Cloud Computing Platform



## Figure 5.10 Amazon Web Services



# What Are the Current Trends in Computer Hardware Platforms? (4 of 4)

- Green computing (Green IT)
  - Practices and technologies for manufacturing, using, disposing of computing and networking hardware
  - Reducing power consumption a high priority
  - Data centers
- High performance, power-saving processors
  - Multicore processors
  - Power-efficient microprocessors

# What Are the Current Computer Software Platforms and Trends? (1 of 3)

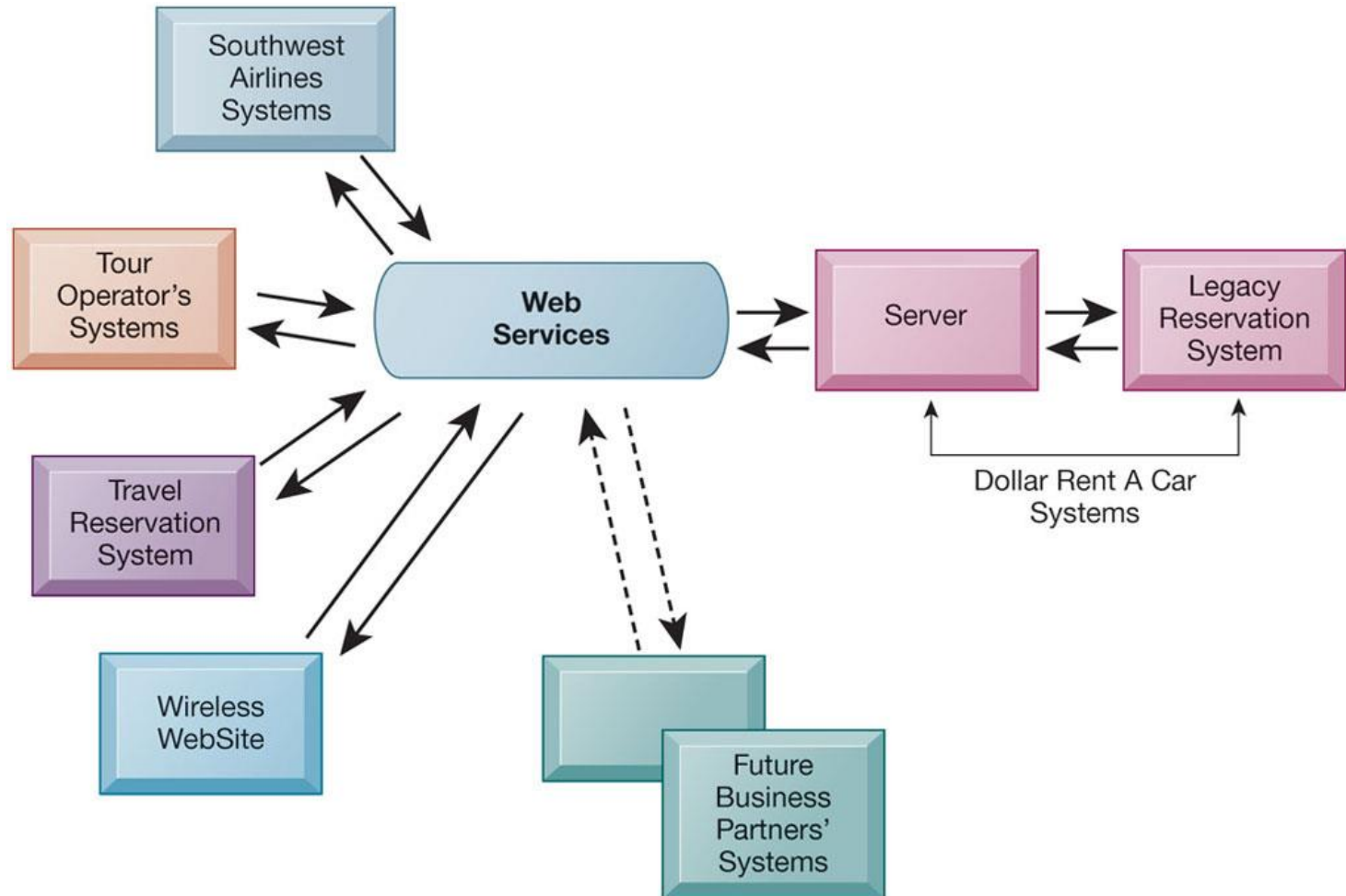
- Linux and open-source software
  - Produced by community of programmers
  - Examples: Apache web server, Mozilla Firefox browser, OpenOffice
  - Linux
- Software for the web: Java, HTML, and HTML5
  - Java Virtual Machine
  - Web browsers
  - HTML and HTML5
  - Ruby and Python

# What Are the Current Computer Software Platforms and Trends? (2 of 3)

- Web services and service-oriented architecture
  - Web services
  - XML: Extensible Markup Language
  - SOA: service-oriented architecture
    - Set of self-contained services that communicate with one another to create a working software application
    - Software developers reuse these services in other combinations to assemble other applications as needed



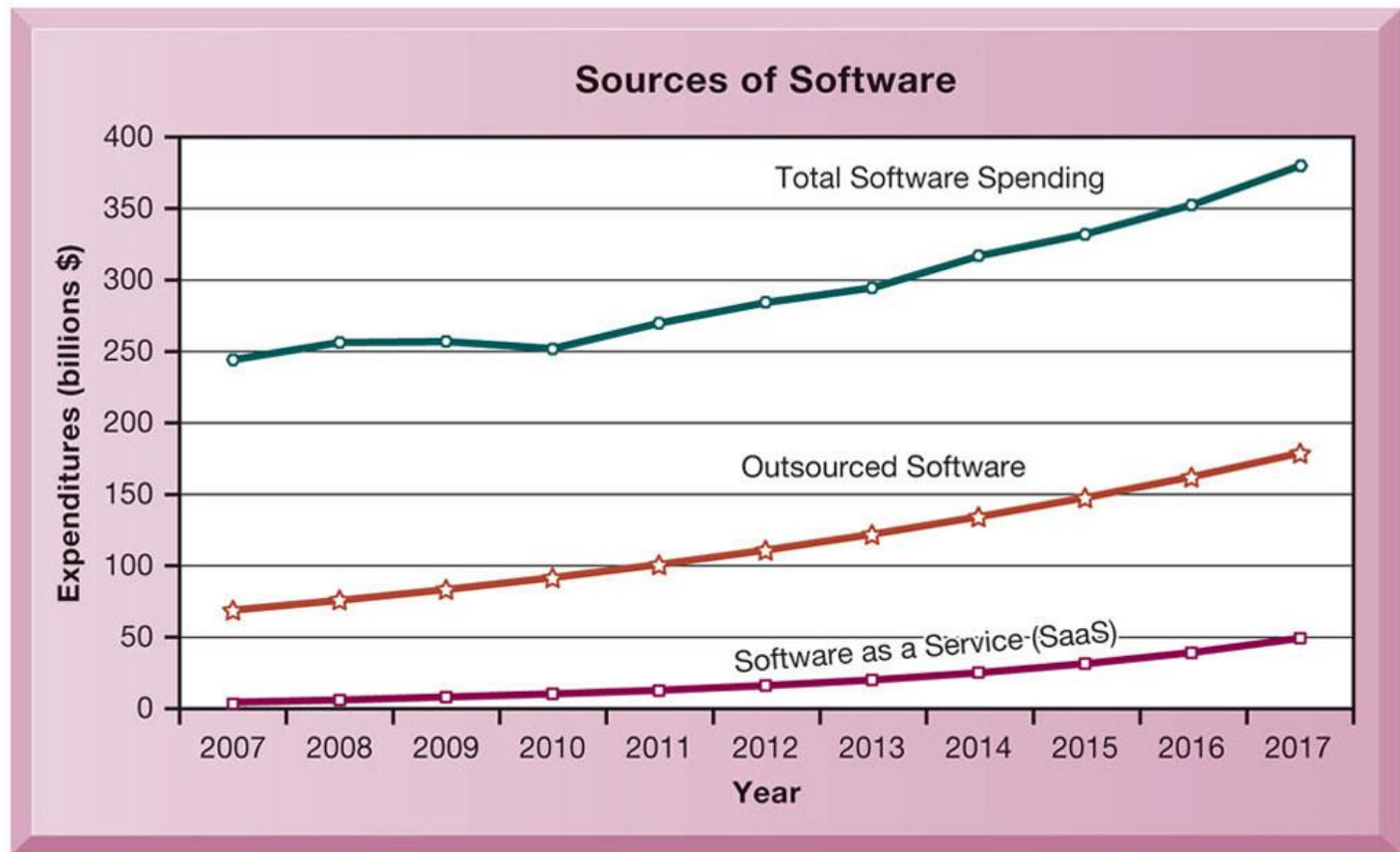
## Figure 5.11 How Dollar Rent A Car Uses Web Services



# What Are the Current Computer Software Platforms and Trends? (3 of 3)

- Software outsourcing and cloud services
  - Software packages and enterprise software
  - Software outsourcing
  - Cloud-based software services and tools
    - Service Level Agreements (SLAs): formal agreement with service providers
- Mashups and apps

# Figure 5.12 Changing Sources of Firm Software



# Dealing with Platform and Infrastructure Change

- As firms shrink or grow, IT needs to be flexible and scalable
- Scalability
  - Ability to expand to serve larger number of users
- For mobile computing and cloud computing
  - New policies and procedures for managing these new platforms
  - Contractual agreements with firms running clouds and distributing software required

# Management and Governance

- Governance
- Who controls IT infrastructure?
- How should IT department be organized?
  - Centralized
    - Central IT department makes decisions
  - Decentralized
    - Business unit IT departments make own decisions
- How are costs allocated between divisions, departments?

# Making Wise Infrastructure Investments

- Under-investment and over-investment can hamper firm performance
- Rent-versus-buy
- Cloud computing
  - Security requirements
  - Impact on business processes and workflow
- Outsourcing

# Total Cost of Ownership (TCO) Model

- Analyzes direct and indirect costs
- Hardware, software account for only about 20% of TCO
- Other costs: Installation, training, support, maintenance, infrastructure, downtime, space, and energy
- TCO can be reduced
  - Use of cloud services, greater centralization and standardization of hardware and software resources

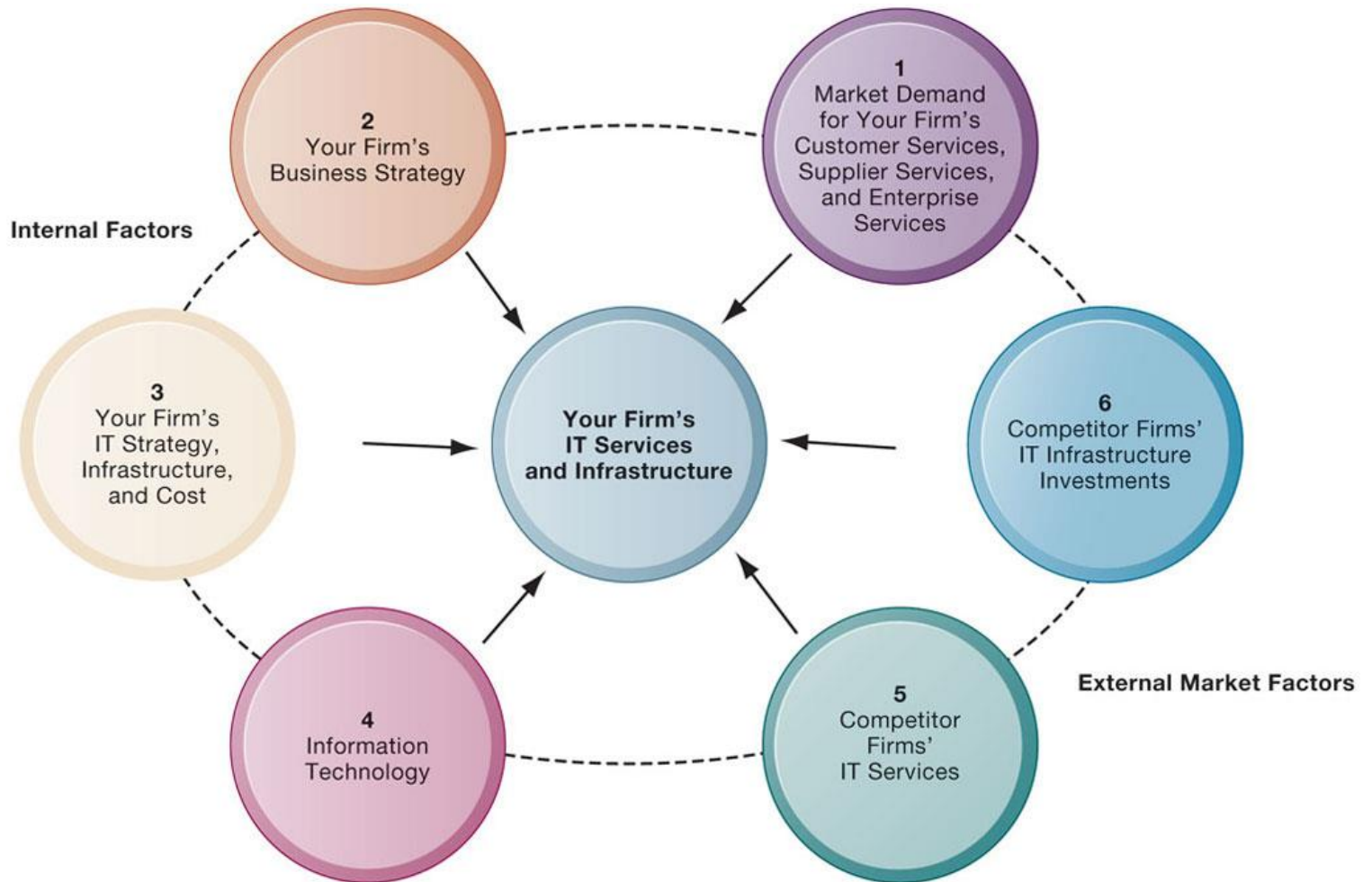
# Competitive Forces Model for IT Infrastructure Investment

- Market demand for firm's services
- Firm's business strategy
- Firm's IT strategy, infrastructure, and cost
- Information technology assessment
- Competitor firm services
- Competitor firm IT infrastructure investments



# Figure 5.13

## Competitive Forces Model for IT Infrastructure



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