

Chapter 5

IT Infrastructure and Emerging Technologies

True-False Questions

1. IT infrastructure technology is purely a set of physical devices and software applications that are required to operate the entire enterprise.
Answer: False **Difficulty: Easy** **Reference: pp. 171–172**
2. Client/server computing is a widely used form of centralized processing.
Answer: False **Difficulty: Medium** **Reference: pp. 175, 178**
3. In two-tiered client/server architecture, the processing is split between two types of servers.
Answer: False **Difficulty: Hard** **Reference: p. 175**
4. Application server software is responsible for locating and managing stored Web pages.
Answer: False **Difficulty: Medium** **Reference: p. 176**
5. An application server may reside on the same computer as a Web server or on its own dedicated computer.
Answer: True **Difficulty: Medium** **Reference: p. 176**
6. Enterprise integration requires software that can link disparate applications and enable data to flow freely among different parts of the business.
Answer: : True **Difficulty: Medium** **Reference: p. 177**
7. The mainframe market has grown steadily over the past decade.
Answer: True **Difficulty: Medium** **Reference: p. 186**
8. The operating system is used to manage the computer's activities.
Answer: True **Difficulty: Easy** **Reference: p. 186**
9. SANs create large central pools of storage that can be rapidly accessed and shared by multiple servers.
Answer: True **Difficulty: Medium** **Reference: p. 187**

10. Like an ASP, a Web hosting service provides shared applications to subscribed users, but does this through a Web portal.
- Answer: False** **Difficulty: Medium** **Reference: p. 188**
11. Autonomic computing is implemented primarily with enterprise or ISP servers.
- Answer: False** **Difficulty: Medium** **Reference: p. 192**
12. N-tier computing is a multi-tier, load-balancing scheme for Web-based applications in which significant parts of Web site content, logic, and processing are performed by smaller, less expensive servers located nearby the user.
- Answer: True** **Difficulty: Hard** **Reference: pp. 175–176**
13. Java software is designed to run on any computer or computing device, regardless of the specific microprocessor or operating system it uses.
- Answer: True** **Difficulty: Easy** **Reference: p. 198**
14. Web services can exchange information between two different systems regardless of the operating system or programming languages on which the systems are based.
- Answer: True** **Difficulty: Medium** **Reference: p. 200**
15. XML is limited to describing how data should be presented in the form of Web pages; HTML can perform presentation, communication, and storage of data.
- Answer: False** **Difficulty: Easy** **Reference: p. 200**
16. Hypertext markup language specifies how text, graphics, video, and sound are placed on a Web page document.
- Answer: True** **Difficulty: Easy** **Reference: p. 200**
17. The collection of Web services that are used to build a firm's software systems constitutes what is known as a service-oriented architecture.
- Answer: True** **Difficulty: Medium** **Reference: p. 201**
18. Today most business firms have discontinued operating their legacy systems, replacing these with inexpensive Web services and hosted software.
- Answer: False** **Difficulty: Medium** **Reference: p. 204**
19. Scalability refers to the ability of a computer, product, or system to expand to serve a large number of users without breaking down.
- Answer: True** **Difficulty: Easy** **Reference: p. 209**

20. TCO refers to the original cost of purchased technology: both hardware and software.

Answer: False

Difficulty: Easy

Reference: p. 211

Multiple-Choice Questions

21. *Synthesis*

As discussed in the chapter case, DreamWorks Animation invested in IT infrastructure in order to counter which competitive force?

- a. Traditional competitors
- b. New market entrants
- c. Customers
- d. Substitute products

Answer: a

Difficulty: Hard

Reference: p. 169

Synthesis in terms of formulate

22. Which type of infrastructure services provide voice and video connectivity to employees, customers, and suppliers?

- a. Networking
- b. Telephone
- c. VOIP
- d. Telecommunications

Answer: d

Difficulty: Easy

Reference: p. 172

23. Which of the following is not an IT infrastructure service component?

- a. Operating system software
- b. Computing platforms to provide a coherent digital environment
- c. Physical facility management to manage the facilities housing physical components
- d. IT management services to plan and develop the infrastructure and provide project management

Answer: a

Difficulty: Easy

Reference: p. 172

24. *Synthesis*

Place the following eras of IT infrastructure evolution in order, from earliest to most recent: (1) Mainframe and Minicomputer; (2) Client/Server; (3) Enterprise Internet; (4) Personal Computer; and (5) Electronic Accounting Machine.

- a. 5, 1, 2, 3, 4
- b. 5, 1, 4, 2, 3
- c. 1, 5, 4, 2, 3
- d. 1, 5, 2, 3, 4

Answer: b

Difficulty: Medium

Reference: p. 174

25. The introduction of the minicomputer:

- a. allowed computers to be customized to the specific needs of departments or business units.
- b. enabled decentralized computing.
- c. offered new, powerful machines at lower prices than mainframes.
- d. all of the above.

Answer: d

Difficulty: Medium

Reference: p. 175

26. In a multi-tiered network:

- a. the work of the entire network is centralized.
- b. the work of the entire network is balanced over several levels of servers.
- c. processing is split between clients and servers.
- d. processing is handled by multiple, geographically remote clients.

Answer: b

Difficulty: Easy

Reference: pp. 175–176

27. A client computer networked to a server computer, with processing split between the two types of machines, is called a:

- a. service-oriented architecture.
- b. on-demand architecture.
- c. multi-tiered client/server architecture.
- d. two-tiered client/server architecture.

Answer: d

Difficulty: Easy

Reference: p. 175

28. Interpretations of Moore's law assert that:

- a. computing power doubles every 18 months.
- b. transistors decrease in size 50% every two years.
- c. data storage costs decrease by 50% every 18 months.
- d. none of the above.

Answer: a

Difficulty: Medium

Reference: p. 177

29. Today's nanotechnology-produced computer transistors are roughly equivalent in size to:
- a. the width of a fingernail.
 - b. a human hair.
 - c. a virus.
 - d. an atom.

Answer: c **Difficulty: Medium** **Reference: p. 180**

30. Which of the following factors provides an understanding of why computing resources today are ever more available than in previous decades?
- a. Network economics
 - b. Law of mass digital storage and Moore's law
 - c. Declining communications costs, universal standards, and the Internet
 - d. All of the above

Answer: d **Difficulty: Medium** **Reference: pp. 177–183**

31. Specifications that establish the compatibility of products and the ability to communicate in a network are called:
- a. network standards.
 - b. telecommunications standards.
 - c. technology standards.
 - d. Internet standards.

Answer: c **Difficulty: Medium** **Reference: p. 183**

32. _____ unleash powerful economies of scale and result in declines in manufactured computer products.
- a. Internet and web technologies
 - b. Technology standards
 - c. Linux and open-source software
 - d. Client/server technologies

Answer: b **Difficulty: Medium** **Reference: p. 183**

33. The multitasking, multi-user, operating system developed by Bell Laboratories that operates on a wide variety of computing platforms is:
- a. Unix.
 - b. Linux.
 - c. Mac OS.
 - d. COBOL.

Answer: a **Difficulty: Hard** **Reference: p. 184**

34. Software that manages the resources of the computer is called:

- a. operating system software.
- b. application software.
- c. data management software.
- d. network software.

Answer: a

Difficulty: Easy

Reference: p. 186

35. A SAN is a:

- a. server area network.
- b. storage area network.
- c. scalable architecture network.
- d. service-oriented architecture network.

Answer: b

Difficulty: Easy

Reference: p. 187

36. As referred to in the text, legacy systems are:

- a. traditional mainframe-based business information systems.
- b. electronic spreadsheets used on a PC.
- c. any pre-1990 Wintel systems.
- d. systems found on older ASPs.

Answer: a

Difficulty: Easy

Reference: p. 189

37. Legacy systems are still used because:

- a. they can only be run on the older mainframe computers.
- b. they are too expensive to redesign.
- c. many integrate well using new Web services technologies.
- d. they contain valuable data that would be lost during redesign.

Answer: b

Difficulty: Easy

Reference: p. 189

38. Connecting geographically remote computers in a single network to create a “virtual supercomputer” is called:

- a. co-location.
- b. edge computing.
- c. grid computing.
- d. utility computing.

Answer: c

Difficulty: Easy

Reference: p. 190

39. An example of technology convergence is:
- virus protection software that runs and updates itself automatically.
 - software programmed to run on any hardware platform.
 - cell phones taking on the functions of handheld computers.
 - programming languages that allow non-programmers to create custom applications.

Answer: c **Difficulty: Easy** **Reference: p. 190**

40. This type of computing refers to firms off-loading peak requests for computing power to remote, large-scale data processing centers.
- On-demand
 - Grid
 - Edge
 - Autonomic

Answer: a **Difficulty: Medium** **Reference: p. 191**

41. When a firm purchases computing power from a central computing service and pays only for the amount of computing power it uses, this is commonly referred to as:
- grid computing.
 - utility computing.
 - edge computing.
 - autonomic computing.

Answer: b **Difficulty: Medium** **Reference: p. 191**

42. The business case for using grid computing involves all of the following EXCEPT:
- cost savings.
 - increased accuracy.
 - speed of computation.
 - agility.

Answer: b **Difficulty: Medium** **Reference: p. 191**

43. *Analysis*

An example of autonomic computing is:

- spyware protection software that runs and updates itself automatically.
- software programmed to run on any hardware platform.
- cell phones taking on the functions of handheld computers.
- programming languages that allow non-programmers to create custom applications.

Answer: a **Difficulty: Medium** **Reference: p. 192**

44. The components of edge computing are:

- a. local client, ISP servers, corporate enterprise servers.
- b. local client, corporate Web servers, corporate enterprise servers.
- c. ISP servers, corporate Web servers, corporate enterprise servers.
- d. ISP servers, corporate enterprise servers, Web servers.

Answer: a

Difficulty: Medium

Reference: pp. 192–193

45. An industry-wide effort to develop systems that can configure, optimize, tune, and heal themselves when broken, and protect themselves from outside intruders and self-destruction is called:

- a. grid computing.
- b. utility computing.
- c. edge computing.
- d. autonomic computing.

Answer: d

Difficulty: Medium

Reference: p. 192

46. As discussed in the chapter case, the major driver for E*Trade's adoption of Linux was:

- a. cost.
- b. reliability.
- c. ease-of-use.
- d. integration with existing back-office integrations.

Answer: a

Difficulty: Medium

Reference: p. 196

47. Linux is:

- a. primarily concerned with the tasks of end users.
- b. designed for specific machines and specific microprocessors.
- c. an example of open-source software.
- d. especially useful for processing numeric data.

Answer: c

Difficulty: Medium

Reference: p. 195

48. Which type of software is created and updated by a worldwide community of programmers and available for free?

- a. Software packages
- b. Mashups
- c. Outsourced
- d. Open source

Answer: d

Difficulty: Easy

Reference: p. 195

49. A software tool with a graphical user interface for displaying Web pages and for accessing the Web and other Internet resources is called a:
- JVM.
 - Web browser.
 - FTP client.
 - All of the above.

Answer: b **Difficulty: Easy** **Reference: p. 198**

50. The single most urgent software priority for U.S. firms is:
- integrating Internet technologies.
 - integrating legacy applications with newer Web-based technologies into a single system.
 - standardizing existing applications.
 - replacing legacy applications with newer technologies and services.

Answer: b **Difficulty: Medium** **Reference: p. 198**

51. Running a Java program on a computer:
- requires a Java Virtual Machine to be installed on the computer.
 - requires a Java Virtual Machine to be installed on the server hosting the Java applet.
 - requires a miniature program to be downloaded to the user's computer.
 - does not require any specialized software, as Java is platform-independent.

Answer: a **Difficulty: Medium** **Reference: p. 198**

52. Commercially available software that enables multiple systems to exchange data through a single software hub is called:
- SOAP.
 - WSDL services.
 - EAI software.
 - XML software.

Answer: c **Difficulty: Medium** **Reference: p. 199**

53. Software that connects two disparate applications, allowing them to communicate with each other and to exchange data, is called:
- enterprise software.
 - integration software.
 - distributed software.
 - middleware.

Answer: d **Difficulty: Easy** **Reference: p. 199**

54. HTML is a:

- a. hybrid language providing more flexibility than the popular language in current use.
- b. language that delivers only the software functionality needed for a specific task.
- c. page description language for creating Web pages and other hypermedia documents.
- d. language that combines data and program code.

Answer: c

Difficulty: Medium

Reference: p. 200

55. What is the foundation technology for Web services?

- a. XML
- b. HTML
- c. SOAP
- d. UDDI

Answer: a

Difficulty: Medium

Reference: p. 200

56. Sets of loosely coupled software components that exchange information with each other using standard Web communication standards and languages are referred to as:

- a. Web services.
- b. EAI software.
- c. SOA.
- d. SOAP.

Answer: a

Difficulty: Medium

Reference: p. 200

57. A set of self-contained services that communicate with each other to create a working software application is called:

- a. Web services.
- b. EAI software.
- c. SOA.
- d. SOAP.

Answer: c

Difficulty: Medium

Reference: p. 201

58. Which of the following is an example of an SOA environment?

- a. Amazon.com's operation of hundreds of services, such as billing or customer interface, delivered by different application servers
- b. E*Trade's use of lower-cost Linux servers that delivered increased computer performance
- c. Thermos's use of hosted Oracle systems software running on Oracle's computers
- d. None of the above

Answer: a

Difficulty: Medium

Reference: p. 201

59. *Synthesis*

Which competitive strategies can be enhanced through the use of SOAs to connect with partners in a business ecosystem?

- a. Low-cost leadership and product differentiation
- b. Focus on market niche and product differentiation
- c. Low-cost leadership, product differentiation, and strengthening customer and supplier intimacy
- d. Focus on market niche, low-cost leadership, and strengthening customer and supplier intimacy

Answer: c

Difficulty: Hard

Reference: p. 201

Synthesis in terms of bringing knowledge from different sources together

60. Software applications that are based on combining different online software applications are called:

- a. integrated software.
- b. Ajax.
- c. mashups.
- d. edge computing.

Answer: c

Difficulty: Easy

Reference: p. 203

61. This model can be used to analyze the direct and indirect costs to help firms determine the actual cost of specific technology implementations.

- a. Total cost of ownership
- b. Return on investment
- c. Breakeven point
- d. Cost benefit analysis

Answer: a

Difficulty: Easy

Reference: p. 211

62. Prewritten, commercially available sets of software programs that eliminate the need for a firm to write its own software programs for certain functions, are referred to as:

- a. software packages.
- b. mashups.
- c. outsourced.
- d. open source.

Answer: a

Difficulty: Easy

Reference: pp. 204–205

63. The practice of contracting custom software development to an outside firm is commonly referred to as:

- a. outsourcing.
- b. scaling.
- c. service-oriented architecture.
- d. application integration.

Answer: a

Difficulty: Easy

Reference: p. 204

64. An ASP:

- a. supplies online access over networks to storage devices and storage area network technology.
- b. manages combinations of applications, networks, systems, storage, and security as well as providing Web site and systems performance monitoring to subscribers over the Internet.
- c. uses centrally managed facilities to host and manage access to package applications delivered over networks on a subscription basis.
- d. all of the above.

Answer: c

Difficulty: Hard

Reference: pp. 205–206

65. The time-sharing services of the 1970s, which ran applications such as payroll on their computers for other companies, were an early version of:

- a. ASPs.
- b. outsourcing.
- c. Ajax.
- d. Web services.

Answer: a

Difficulty: Hard

Reference: p. 206

66. As discussed in the Interactive Session: Technology, ResortCom's use of a hosted on-demand CRM illustrated:

- a. the benefits of adapting to the business processes embedded in enterprise software.
- b. the difficulties in adapting to the business processes embedded in enterprise software.
- c. the challenges involved in customizing enterprise software.
- d. the speed with which a hosted enterprise solution can be brought online to replace existing back-office applications.

Answer: c

Difficulty: Medium

Reference: pp. 207–208

67. Which of the following refers to the ability of a computer, product, or system to expand to serve a larger number of users without breaking down?
- Modifiability
 - Scalability
 - Expandability
 - Disintermediation

Answer: b

Difficulty: Easy

Reference: p. 209

68. How would you determine the market demand for your firm's IT services?
- Perform a TCO analysis.
 - Perform a benchmarking on these services.
 - Hold focus groups to assess your services.
 - Analyze sales returns on key investments.

Answer: c

Difficulty: Easy

Reference: p. 209

69. *Evaluate*

Your firm, an auto parts manufacturer, has just merged with an automobile engine manufacturer, and the two companies have different SCM systems. Which of the following strategies would be the most likely course to help to reduce the TCO of the merged firms' technology investments?

- Use Web services to join the two systems.
- Move one firm into using the other's system in order to centralize management and support services.
- Develop single ERP system that encompasses the information needs and business processes of both firms.
- Purchase a hosted, on-demand ERP system that encompasses the needs and processes of both firms.

Answer: b

Difficulty: Hard

Reference: p. 211

Evaluate in terms of judge, predict

70. *Analysis*

As discussed in the chapter case study, Merrill Lynch's IT investments to modernize its technology infrastructure illustrates the use of what software technology trend?

- a. On-demand computing
- b. Outsourcing
- c. Java
- d. Web services

Answer: d

Difficulty: Medium

Reference: pp. 218–220

Analysis in terms of categorize

Business Leaders

Fill in the Blanks

71. In the n-tier architecture, the work of the entire network is balanced over multiple levels of servers.

Difficulty: Medium Reference: pp. 175–176

72. Storage area networks connect multiple storage devices on a separate high-speed network dedicated to storage.

Difficulty: Medium Reference: p. 187

73. Legacy systems are generally older transaction processing systems created for mainframe computers that continue to be used to avoid the high cost of replacing or redesigning them.

Difficulty: Medium Reference: p. 189

74. On-demand computing refers to firms off-loading peak demand for computing power to remote, large-scale data processing centers.

Difficulty: Medium Reference: p. 191

75. Utility computing is the model of computing in which companies pay only for the information technology resources they actually use during a specified time.

Difficulty: Medium Reference: p. 191

76. Autonomic computing is an industry-wide effort to develop systems that can configure, optimize, tune, heal, and protect themselves from outside intruders and self-destruction.

Difficulty: Medium Reference: p. 192

77. Middleware is software that connects two otherwise separate applications, enabling them to communicate with each other and to exchange data.

Difficulty: Medium Reference: p. 199

78. XML provides a standard format for data exchange, enabling Web services to pass data from one process to another

Difficulty: Medium Reference: p. 200

79. Outsourcing takes place when a firm contracts custom software development or maintenance of existing legacy programs to outside firms.

Difficulty: Easy Reference: p. 206

80. The ***total cost of ownership (TCO)*** model can be used to analyze the direct and indirect costs to help firms determine the actual cost of specific technology implementations.

Difficulty: Medium

Reference: p. 211

Essay Questions

81. **List and describe the major components of IT infrastructure.**

Computer hardware platforms. Consists of technology for computer processing and includes client and server machines and mainframes.

Computer software platforms. Includes system software, application software, and enterprise applications.

Data management and storage. Includes database management software and hardware for storage, such as disk arrays, tape libraries, and SANs.

Networking and telecommunications platforms. Include telecommunication services for voice lines and Internet access, as well as cellular phone services.

Internet platforms. includes hardware, software, and management services for maintaining Web sites, intranets, and extranets.

Consulting and system integration services. Includes consulting services and staff for maintaining legacy systems and integrating older systems with new infrastructure technologies.

Difficulty: Medium

Reference: pp. 183–189

82. **Briefly explain why corporations are increasingly interested in using Unix or Linux for their operating system.**

Linux is an inexpensive and robust open-source relative of Unix. Unix and Linux constitute the backbone of corporate infrastructure throughout much of the world because they are scalable, reliable, and much less expensive than mainframe operating systems. They can also run on many different types of processors. The major providers of Unix operating systems are IBM, HP, and Sun with slightly different and partially incompatible versions.

Although Windows continues to dominate the client marketplace, many corporations have begun to explore Linux as a low-cost desktop operating system provided by commercial vendors such as RedHat Linux and Linux-based desktop productivity suites such as Sun's StarOffice. Linux is also available in free versions downloadable from the Internet as open-source software. The rise of open-source software, particularly Linux and the applications it supports at the client and server level, has profound implications for corporate software platforms: cost, reduction, reliability and resilience, and integration, because Linux works on all the major hardware platforms from mainframes to servers to clients. Linux has the potential to break Microsoft's monopoly on the desktop. Sun's StarOffice has an inexpensive Linux-based version that competes with Microsoft's Office productivity suite.

Difficulty: Medium Reference: pp. 195–197

83. **Distinguish between grid computing, edge computing, on-demand computing, and autonomic computing.**

- **Grid computing** involves connecting geographically remote computers into a single network to create a computational grid that combines the computing power of all the computers on the network with which to attack large computing problems.
- **Edge computing** balances the processing load for Web-based applications by distributing parts of the Web content, logic, and processing among multiple servers.
- **On-demand computing** also depends on networks for firms to purchase additional processing power from large computer service firms and to have that power delivered when they need it over a network.
- **Autonomic computing** seeks to develop systems that can configure themselves, optimize and tune themselves, heal themselves when broken, and protect themselves from internal and external threats.

Difficulty: Medium Reference: pp. 190–193

84. **Identify and describe five or more of the current trends in contemporary software platforms.**

- **Growing use of Linux and open-source software.** Open-source software is produced and maintained by a global community of programmers and is downloadable for free. Linux is a powerful, resilient open-source operating system that can run on multiple hardware platforms and is used widely to run Web servers.
- **Java** is an operating system and hardware-independent programming language that is the leading interactive programming environment for the Web.
- **Web services and service-oriented architecture.** Software for enterprise integration includes enterprise applications and middleware such as enterprise application integration (EAI) software and Web services. Unlike EAI software, Web services are loosely coupled software components based on open Web standards that are not product-specific and can work with any application software and operating system. They can be used as components of Web-based applications linking the systems of two different organizations or to link disparate systems of a single company.
- New software techniques such as Ajax and RIA for enabling Web applications, and trends for combining Web applications to create new products (**mashups**).
- New ways to think about Web applications, in the trend of Web 2.0, which emphasize services over packaged software, trusting users as co-developers, harnessing collective intelligence, using lightweight development methods.
- **Software outsourcing.** Companies are purchasing their new software applications from outside sources, including application software packages, by outsourcing custom application development to an external vendor (that may be offshore), or by renting software services from an application service provider.

Difficulty: Hard

Reference: pp. 194–206

85. **Web services communicate through XML messages over standard protocols. Distinguish between Simple Object Access Protocol (SOAP), Web Services Description Language (WSDL), and Universal Description, Discovery, and Integration (UDDI).**

- **Simple Object Access Protocol (SOAP)** is a set of rules for structuring messages that enables applications to pass data and instructions to one another.
- **Web Services Description Language (WSDL)** is a common framework for describing the tasks performed by a Web service and the commands and data it will accept so that it can be used by other applications.
- **Universal Description, Discovery, and Integration (UDDI)** enable a Web service to be listed in a directory of Web services so that it can be easily located.

Difficulty: Hard

Reference: p. 200

86. *Evaluation*

What is scalability? Why is it essential to the success of the modern business firm?

Scalability is the ability of the computer, product, or system to expand to survey larger numbers of users without breaking down. It is important because as firms grow, they can quickly outgrow their infrastructure. As firms shrink, they can get stuck with excessive infrastructure purchased in better times. Any modern company must be able to make plans for the future, even though that future may be different than what was expected. Computer equipment is expensive, though dropping in price, and budgets must be planned to allow for new purchases, upgrades, and training. It is generally assumed that a successful company will need more computer capacity for more people as it follows a path to continued success.

Difficulty: Medium

Reference: pp. 208–209

87. *Synthesis*

You are starting a market research company with a single business partner and are planning the hardware and software need for the two of you. Which factors should play into your decision of how much to spend on these investments?

Using the competitive forces model for IT infrastructure investment, the most relevant factors in this decision are:

- **The firm's business strategy.** What capabilities we will want to have over the next five years?
- **Alignment of IT strategy.** How does our IT strategy match up with the business plan?
- **IT assessment.** What are the current technology levels for the services we are offering and our business type? We would probably not need to be at the bleeding edge, but not behind the times either.
- **Competitor firm services.** What technology-enabled capabilities do our competitors have? We would want to match services with our competitors.
- **Competitor firm IT investments.** How much are competitor firms investing in their technology?

Because this is a startup, one other factor may not play such a large role: That of market demand for services. However, finding out what the market demand for competitor's services may uncover ways that this new company could have a competitive advantage.

Difficulty: Hard

Reference: p. 209

88. *Synthesis*

Explain why standards are so important in information technology? What standards have been important for the growth of Internet technologies?

Standards are important because they result in different manufacturer's creating products that can be used either with each other or to communicate with each other. For example, without standards, each light-bulb manufacturer would have to also create specific light-bulb sockets for use with their light-bulbs. In the same way, computers and computer technology have been enabled through standards. Standards have allowed many different manufacturers to contribute to the same, standardized definitions of a technological application. For example, the ASCII data standards made it possible for computer machines from different manufacturers to exchange data, and standardized software languages have enabled programmers to write programs that can be used on different machines.

The standards that have been important for the growth of the Internet include TCP/IP, as a networking standard, and WWW standards for displaying information as Web pages, including HTML.

Difficulty: Hard

Reference: p. 184

Synthesis in terms of create, design

89. *Synthesis*

An international ad-hoc group of climatologists and oceanographers needs to set up a system to analyze massive amounts of data on ocean temperatures, collected hourly by hundreds of ships worldwide. The technology and hardware for gathering the data and transmitting the data to a computer is in place. What additional hardware might they need? What techniques might they use to make their research more efficient and lower costs?

To store their data they may want to use a SAN. To process their data, they will need a supercomputer or grid computing. If they will be using a Web interface to analyze or retrieve data, they could consider implementing edge computing. To lower costs, they could look at on-demand or utility computing as well as virtualization and implementing multicore processors.

Difficulty: Hard

Reference: pp. 189–194

Synthesis in terms of create, design

90. *Synthesis*

A small design agency you are consulting for will be creating client Web sites and wants to purchase a Web server so they can host the sites themselves. How will you advise them on this purchase?

They need to understand total cost of ownership: the costs will go beyond the cost of the server, but they will also need to purchase the server software and any application software they will be using. They will also need someone in their IT department to manage and maintain the computers. They will also incur facilities costs for running the computer. They need to have a backup plan should the server fail. The design agency will need to add up all the potential costs and risks. Additionally, they need to prepare for their plan if they need more servers? Will they eventually have to run and maintain their own server farm? What if one of their clients' sites is more popular than anticipated and the server has difficulty handling the load? How quickly can they add servers or processing power? The company should look at collocation, Web hosting services, and ASPs to see if their needs will be better met this way.

Difficulty: Hard

Reference: pp. 209–211

Synthesis in terms of create, design