Chapter 1
Elements of Data Communications: Analog and Digital

Chapter Outline

Learning Objectives

■ Identify five phases in the evolution of data communications.
■ Explain the difference between data communications and telecommunications.
■ Understand what a protocol is and why protocols are used.
■ Recognize the importance of standards and standards-setting bodies.
■ Identify the OSI and TCP/IP networking models.

Chapter Summary

Five phases characterize the evolution of data communications over the past five decades: (1) digitization, (2) expansion, (3) deregulation, (4) Internet as a common tool, and (5) pervasive computing. Technology continues to change, altering our definition of what is meant by "communications." Data communications is a subset of telecommunications. Whereas telecommunications involves such technologies as telephony and television, traditional data communications is more concerned with the transmission of data between computers and computer networks. In the transmission of data from one location to another, data are first transformed using binary coding schemes. Binary coding schemes use the binary digits 0 and 1, which are called bits, to represent data.

Data communications uses protocols, or rules, that establish how the communications occur. There are many different types of protocols that fulfill different purposes and functionalities. Protocols state how the data are to be formatted, how the format is to be interpreted, the rate at which the data are to be transmitted, and whether communications between two devices can be established. Protocols become established or defined through a standards process. Both formal and informal standards exist. The trend is for standards to be open and publicly available for all to use. There are numerous standards-setting bodies; many of them are nongovernmental, private nonprofit organizations.

Networks have both physical and logical components—respectively, the hardware devices that compose them and the software that drives them. Networks are also based on models. Two major models used in data communications are the Open Systems Interconnection, or OSI, model and the Transmission Control Protocol/Internet Protocol, or TCP/IP, model.

Keywords

ARPANET *4*
Binary *6*
Data communications *6*
De facto standard *9*
Deregulation *4*
Digitization *3*
Encoding scheme *7*
Internet *5*
IPv4 *5*
IPv6 *5*
Nonproprietary *9*
Pervasive technology *5*
Proprietary *3*
Protocol *7*
Standards *9*
Telecommunications *6*
Telemetry *5*

Short-Answer Questions

1. What are open standards, and what, if any, are the advantages of such standards?

Open standards are a nonproprietary standard that establishes the essential rules, functionalities, and operations a protocol must fulfill.

2. What is a protocol and why would one be used? Provide an example of a technological protocol or a society-based protocol.

Protocols are the rules that determine how devices communicate. Language protocols, called rules of grammar, make it possible for people who speak and read the same language to understand one another.

3. How do formal standards differ from de facto standards?

Unlike de facto standards, formal standards are those standards that have been authorized by either an officially recognized body or by law and regulation.

4. What are the five phases associated with the evolution of data communication networks?

1. Digitization in the 1960s.
2. Growth of data communications in the 1970s.
3. An era of deregulation in the 1980s.
4. The Internet as a common tool in the 1990s.
5. Pervasive computing in the 2010s.

5. With what scale of network is the IEEE associated?

Local area networks.

6. What organization is the principal standards-setting body in the United States?

The American National Standards Institute (ANSI).

7. What is an encoding scheme?

An encoding scheme is a way of transforming one type of data or information into another.

8. What is telemetry?

Telemetry is the wireless transmission and reception of data for the purpose of remotely monitoring environmental conditions or equipment parameters.

Hands-On Projects, Research in Brief, and Case Study

Answers for these three text elements will vary depending on what an individual student or study group elects for these assignments. Assignments should be evaluated for relevancy, accuracy, content, and appropriate use of language. The case study in particular lends itself to a small group project.

Chapter 2
Networking Models: OSI and TCP/IP

Chapter Outline

Learning Objectives

■ Explain networking models.
■ Describe open architectures.
■ List the benefits of layered architectures.
■ Understand the OSI networking model.
■ Understand the TCP/IP networking model.
■ Identify four general categories of networks.

Chapter Summary

Networks have both physical and logical components: the hardware devices that compose them and the software that drives them. Networks are also based on models. Open architecture models have some of the same advantages as open standards. Two major models used in data communications are the open systems interconnection, or OSI, model and the transmission control protocol/Internet protocol, or TCP/IP, model.

The two models share several characteristics, and each model is well established and accepted by the data and telecommunications industries. One of the most important features they share is that both models are based on the concept of layered architectures. A model is based on theory. The

theoretical model must then be implemented into a physical data communications network. In general, a network falls into one of four categories, based on the network's characteristics. A local area network (LAN) is usually contained within a limited geographic area. A backbone network (BN) is usually a high-speed circuit that connects the various LANs within an enterprise. A metropolitan area network (MAN) can connect BNs and LANs. Wide area networks (WANs) are used to transport data over great geographic distances, such as across a state, a country, or even the globe.

Keywords

Short-Answer Questions

1. What are open standards, and what, if any, are the advantages of such standards?

Open standards are a nonproprietary standard that establishes the essential rules, functionalities, and operations a protocol must fulfill.

2. In general, why would a layered architecture be viewed as beneficial?

Each layer within a model has its own particular and specific responsibilities and functionalities. As such a given layer does not need to be informed as to how other layers function.

3. What is a protocol and why would one be used?

Protocols are the rules that determine how devices communicate such that a sending and receiving device are able to exchange data and information.

4. What are the four different types of networks?

1. Local Area Networks.
2. Backbone Networks.
3. Metropolitan Area Networks.
4. Wide Area Networks.

5. How many layers make up the OSI model?

Seven layers make up the OSI model.

6. Which layer in the TCP/IP model is closest in alignment with the OSI model?

The physical layer is closest in alignment with the OSI model.

7. What is the purpose of the application layer in the TCP/IP model?

This layer is also sometimes referred to as the *process layer* and is where a protocol stack interfaces with processes on a host machine, enabling that host to communicate across the network.

8. What is the largest scale networking category?

Wide Area Network is the largest scale networking category.

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