

# Fundamentals of Data and Signals

## Chapter 2

### Learning Objectives

- Distinguish between data and signals
- Cite the advantages of digital data and signals over analog data and signals
- Identify the three basic components of a signal
- Discuss the bandwidth of a signal and how it relates to data transfer speed
- Identify signal strength and attenuation and how they are related
- Outline the basic characteristics of transmitting digital data with digital signals, analog data with digital signals, digital data with analog signals, and analog data with analog signals
- List and draw diagrams of the basic digital encoding techniques, including the advantages and disadvantages of each. Identify the different modulation techniques and describe their advantages, disadvantages, and uses
- Identify the different modulation techniques and describe their advantages, disadvantages, and uses
- Identify the two most common digitization techniques and describe their advantages and disadvantages
- Discuss the characteristics and importance of spread spectrum encoding techniques
- Identify the different data codes and how they are used in communication systems

### Chapter Outline

1. Basics of transmission
2. Data and Signals
  - a. Analog versus digital
  - b. Fundamentals of signals
  - c. Loss of signal strength
3. Converting Data into Signals
  - a. Transmitting digital data with digital signals: digital encoding schemes
    - Non-return to zero digital encoding schemes
    - Manchester digital encoding schemes
    - 4B/5B digital encoding scheme
  - b. Transmitting digital data with analog signals

# The Media: Conducted and Wireless

## Chapter 3

### Learning Objectives

- Outline the differences between Category 1, 2, 3, 4, 5, 5e, 6, and 7 twisted pair wire.
- Outline the characteristics of coaxial cable including the advantages and disadvantages.
- Outline the characteristics of fiber optic cable including the advantages and disadvantages.
- Outline the characteristics of terrestrial microwave systems including the advantages and disadvantages.
- Outline the characteristics of satellite microwave systems including the advantages and disadvantages as well as the differences between low earth orbit, middle earth orbit, geosynchronous earth orbit, and highly elliptical earth orbit satellites.
- Describe the basics of wireless radio, including GSM, D-AMPS, PCS systems, and third generation wireless systems.
- Outline the characteristics of pager systems including the advantages and disadvantages.
- Outline the characteristics of short range transmissions, including Bluetooth
- Describe the characteristics, advantages, and disadvantages of wireless application protocol
- Outline the characteristics of broadband wireless systems including the advantages and disadvantages.
- Apply the media selection criteria of cost, speed, distance and expandability, environment, and security to various media in a particular application.

### Chapter Outline

1. What is a transmission media
2. Conducted Media
  - a. Twisted pair wire
  - b. Coaxial cable
  - c. Fiber optic cable
3. Wireless Media
  - a. Terrestrial microwave transmission
  - b. Satellite microwave transmission

## *Advantages and Disadvantages of Local Area Networks*

Local area networks have several advantages, including: hardware and software sharing, workstation survival during network failure, component and system evolution, heterogeneous mix of hardware and software, and access to other LANs, WANs, and mainframe computers. Disadvantages include complexity, maintenance costs, and the network is only as strong as the weakest link.

## *Basic Network Topologies*

Local area networks are interconnected using one of four basic configurations, or topologies: bus/tree, star-wired bus, star-wired ring, and wireless. The choice of topology is occasionally dictated by the physical environment in which the local area network is to be placed. More than likely, the choice of a topology is determined by other factors such as a preferred access method, data transfer speeds, and brand loyalty. Let's examine each of the four topologies, paying special attention to advantages and disadvantages.

## *Medium Access Control Protocols*

A medium access control protocol is part of the software that allows a workstation to place data onto a local area network. Depending on the network's topology, several types of protocols may be applicable. The bottom line with all medium access control protocols is this: if a local area network is a broadcast network, it is imperative that only one workstation at a time be allowed to transmit its data onto the network. In the case of a broadband local area network, which can support multiple channels at the same time, it is imperative that only one workstation at a time be allowed to transmit its data onto a channel on the network. There are three basic categories of medium access control protocols for local area networks: contention-based protocols, such as carrier sense multiple access with collision detection; round robin protocols, such as token passing; and reservation protocols, such as demand priority.

## *Medium Access Control Sublayer*

Although the seven-layer OSI model was designed to support most types of communication systems, it fell short in several areas. One of these areas was the data link layer. Thus, the data link layer has been split into two sublayers: the medium access control sublayer and the logical link control sublayer. The medium access control (MAC) sublayer works more closely with the physical layer and contains a header, computer (physical) addresses, error detection codes, and control information. The logical link control (LLC) sublayer is primarily responsible for logical addressing and providing error control and flow control information.