

Local Area Networks: Internetworking

Chapter 8

Learning Objectives

- List the reasons for interconnecting multiple local area networks and interconnecting local area networks to wide area networks.
- Identify the functions and purpose of a bridge.
- Distinguish a transparent bridge from a source routing bridge.
- Outline how a transparent bridge learns.
- Define a hub and describe the situations in which a hub is used.
- Describe what a switch is and how it differs from other devices.
- Describe the types of situations in which a switch is advantageous.
- Identify the basic features of a network server.
- Describe what a router is and how it differs from other devices.
- Describe the types of situations in which a router is used.

Chapter Outline

2. Why Interconnect Local Area Networks?

Bridges vs hubs vs switches vs routers

3. Bridges

- a. Transparent bridges
 - Transparent bridge learning network addresses
 - Transparent bridge converting frame formats
- b. Source-routing bridges
- c. Remote bridges

4. Hubs

5. Switches

- a. Isolating traffic patterns and providing multiple access
- b. Full duplex switches

6. Network Servers

7. Routers

Quick Quiz

1. What is the difference between a hub, a bridge, a switch, and a router?

A hub broadcasts any input onto all outgoing lines. A bridge interconnects two LANs and provides filtering. A switch replaces a hub and provides filtering. A router interconnects a LAN with a WAN.

2. What are the basic functions of a network server?

A network server holds the network operating system as well as application programs and data set. It may also function as a hub, switch, bridge or router.

Local Area Networks: Software and Support Systems

Chapter 9

Learning Objectives

- Identify the main functions of operating systems and network operating systems and distinguish between the two.
- Identify the basic features of Novell NetWare, Windows NT/2000, Unix and Linux network operating systems.
- Compare and contrast the Novell NetWare, Windows NT/2000, Unix and Linux network operating systems.
- Enumerate the various components of software licenses.
- Identify common examples of network utility software, Internet software, programming tools, and network applications.
- Identify the different types of support devices commonly found on local area networks.

Chapter Outline

2. Network Operating Systems

3. Current Network Operating Systems

a. Novell NetWare

- NetWare 3
- NetWare 4
- NetWare 5
- NetWare 6

b. Microsoft Windows NT/2000

- Windows NT Version 4
- Windows 2000

c. Unix

d. Linux

f. Summary of network operating systems

4. Network Software: Utilities, Tools, and Applications

a. Utilities

- b. Internet server software
 - c. Programming tools
 - d. Application software
5. Software Licensing Agreements
6. LAN Support Devices

Quick Quiz

1. What is a client/server system's primary function?

To accept requests (such as database queries or file retrieval queries) and return results.

2. Enumerate the strengths and weaknesses of NetWare, Windows NT/2000, Unix, and Linux.

Strengths include: NetWare is an excellent file server. Windows NT is an excellent application server providing client/server capabilities to a wide range of applications. Unix, Linux, and OS/2 give power and flexibility by providing a wide range of services to many different types of network applications.

3. Why does a software company need a software license?

To protect itself from people or companies that make unlimited copies of the software.

4. Compile a list of LAN support devices.

Backup, UPS, printers, media converters, workstations, other?

Introduction to Metropolitan Area Networks and Wide Area Networks

Chapter 10

Learning Objectives

- Distinguish local area networks, metropolitan area networks, and wide area networks from each other.
- Identify the characteristics of metropolitan area networks, and explain how they compare to and contrast with wide area and local area networks.
- Describe how circuit-switched, datagram packet-switched, and virtual circuit packet-switched networks work.
- Identify the differences between a connection-oriented network and a connectionless network, and give an example of each.
- Describe the differences between centralized routing and distributed routing, citing the advantages and disadvantages of each.
- Describe the differences between static routing and adaptive routing, citing the advantages and disadvantages of each.
- Document the main characteristics of flooding, and use hop count and hop limit in a simple example.
- Discuss the basic concepts of network congestion including Quality of Service.

Chapter Outline

2. Metropolitan Area Network Basics

- a. SONET versus Ethernet

3. Wide Area Network Basics

- a. Types of network subnets

- Circuit switched subnet
- Packet switched subnet
- Broadcast subnet

- b. Connection-oriented versus connectionless network applications

- c. Combinations of network applications with subnet types

4. Routing

- a. Dijkstra's least cost algorithm
 - b. Flooding
 - c. Centralized routing
 - d. Distributed routing
 - e. Isolated routing
 - f. Adaptive routing versus static routing
 - g. Routing examples
5. Network Congestion
- a. Avoiding and handling network congestion
 - b. Avoiding congestion with Quality of Service

Quick Quiz

1. What are the main differences between circuit-switched subnets and packet-switched subnets?

Circuit-switched: dedicated, physical circuit; all traffic follows this path; charged for duration of circuit.

Packet-switched: not a dedicated, physical circuit; path may be shared by other users; data sent as packets; packets may follow different paths.

2. What are the main differences between connectionless networks and connection-oriented networks?

Connectionless: no connection is made before data is transmitted; very simple error control, if any.

Connection-oriented: connection must be made before any data sent; error control often more elaborate.

3. What are the basic routing techniques?

Static, dynamic, centralized, distributed, least cost, flooding.

The Internet

Chapter 11

Learning Objectives

- Discuss the responsibilities of the Internet Protocol (IP) and how IP can be used to create a connection between networks.
- Discuss the responsibilities of the Transmission Control Protocol (TCP) and how it can be used to create a reliable, end-to-end network connection.
- Identify the relationships between TCP/IP and the protocols ICMP, UDP, ARP, DHCP, NAT, and tunneling protocols.
- Cite the basic features of HTML, Dynamic HTML, and XML and describe how they differ from each other.
- Describe the parts of a Uniform Resource Locator (URL).
- Describe the responsibility of the Domain Name System and how it converts a URL into a dotted decimal IP address.
- Describe the major Internet applications and services.
- Discuss the business advantages of the World Wide Web.
- Describe the importance of e-commerce and the importance of e-retailing, electronic data interchange, micro-marketing, and electronic security.
- Recognize that intranets and extranets are business-related Internet systems primarily for in-house use.
- Recognize that the Internet is constantly evolving and that IPv6 and Internet2 demonstrate that evolution.
- What is a search engine and how it works.

Chapter Outline

2. Internet Protocols

- a. The Internet Protocol (IP)
 - IP datagram format
- b. The Transmission Control Protocol (TCP)
 - TCP datagram format
- c. Internet Control Message Protocol (ICMP)
- d. User Datagram Protocol (UDP)
- e. Address Resolution Protocol (ARP)
- f. Dynamic Host Configuration Protocol (DHCP)
- g. Network Address Translation (NAT)

- h. Tunneling protocols
3. The World Wide Web
 - a. Locating a document on the Internet
 - Uniform Resource Locator (URL)
 - Domain Name System (DNS) and IP Addresses
 - b. Creating web pages
 - HyperText Markup Language (HTML)
 - Dynamic HTML
 - Extensible Markup Language (XML)
 4. Internet Services
 - a. Electronic mail (e-mail) (SMTP)
 - b. File transfer protocol (FTP)
 - c. Remote login (Telnet)
 - d. Internet telephony
 - e. Listservs
 - f. Usenet
 - g. Streaming audio and video
 5. The Internet and Business
 - a. Cookies and state information
 - b. Intranets and Extranets
 6. The Future of the Internet
 - a. Ipv6
 - b. Internet2

Search Engines

- How they work
- What they consist of

Quick Quiz

1. What is the relationship between the Internet and World Wide Web?

The World Wide Web is one service of many offered by the Internet.

2. What is the relationship between HTTP and HTML?

HTTP is the protocol to transfer web pages and HTML is the scripting language that displays web pages.

3. What are the principal functions of TCP and IP?

TCP provides an error-free end-to-end connection while IP provides a connectionless network packet transfer service.

Telecommunications Systems

Chapter 12

Learning Objectives

- Identify the basic elements of a telephone system, and discuss the limitations of telephone signals.
- Describe the difference between a local exchange carrier and an interexchange carrier and the services they offer.
- Differentiate between the role of the local telephone company before and after the Telecommunications Act of 1996.
- Outline the features of ISDN and distinguish a basic rate interface from a primary rate interface.
- List the advantages of using frame relay for transmitting data.
- Describe a frame relay permanent virtual circuit and how it is created.
- Outline the basic features of frame relay's committed information rate and how it is used to establish a level of service.
- List the differences between data over frame relay and data over the Internet.
- Compare a frame relay switched virtual circuit to a permanent virtual circuit.
- Identify the main characteristics of asynchronous transfer mode, including the roles of the virtual path connection and the virtual channel connection.
- Discuss the importance of the classes of service available with asynchronous transfer mode as well as the ATM's advantages and disadvantages.
- Identify the main characteristics of digital subscriber line, and know the difference between a symmetric system and an asymmetric system.
- Recognize the characteristics and possibilities formed by the merger of the data communications field with the voice communications field into the area of computer telephony integration.

Chapter Outline

2. Basic Telephone Systems

- a. The telephone network before and after 1984
- b. Telephone networks after 1996
- c. Telephone lines, trunks, and numbers
- d. Limitations of telephone signals

3. Leased Line Services

4. Integrated Services Digital Network (ISDN)

5. Frame Relay

- a. Frame relay setup
- b. Committed Information Rate (CIR)
- c. Frame relay vs. the Internet
- d. Voice over Frame Relay (VoFR)
- e. Frame relay switched virtual circuits

6. Asynchronous Transfer Mode (ATM)

- a. ATM classes of service
- b. Advantages and disadvantages of ATM

7. Digital Subscriber Line

- a. DSL basics
- b. DSL formats
- c. Comparison of DSL to ISDN, frame relay, ATM, and cable modems

Quick Quiz

1. What is the difference between a POTS line and a leased line?

POTS line is voice-grade, dial-up, while a leased line is better quality, and is always on.

2. What is frame relay used for?

Frame relay is a high-speed data packet transfer service for local and long distance. Frame relay can also carry voice now.

3. What is asynchronous transfer mode used for?

Asynchronous transfer mode is also a high-speed data packet transfer service but can support a wide variety of traffic types at very high transfer speeds.

4. What are the primary uses of digital subscriber line and cable modems?

They both are used to provide home and business users with high-speed connections to the Internet.

Network Security

Chapter 13

Learning Objectives

- Recognize the concepts of basic security measures.
- Cite the strengths and weaknesses of passwords.
- List the three basic techniques used to discover and eliminate viruses.
- Recognize the basic forms of denial of service attacks.
- Know what a cipher is.
- Outline the basic features of public key cryptography.
- Cite the uses and basic operating characteristics of the Data Encryption Standard.
- Discuss the advantages and uses of digital certificates.
- List the characteristics and common applications areas of public key infrastructure as well as the basic characteristics of a certificate and a certificate authority.
- Recognize the importance of a firewall and be able to describe the two basic types of firewall protection.

Chapter Outline

2. Basic Security Measures
 - a. External security
 - b. Operational security
 - c. Surveillance
 - d. Passwords and ID systems
 - e. Auditing
 - f. Access rights
 - g. Guarding against viruses
3. Standard System Attacks
4. Basic Encryption and Decryption Techniques
 - a. Monoalphabetic substitution-based ciphers
 - c. Transposition-based ciphers
 - d. Public key cryptography and secure sockets layer
 - e. Data Encryption Standard and Advanced Encryption Standard
 - f. Digital signatures

- g. Pretty Good Privacy (PGP)
- 5. Public Key Infrastructure
- 6. Firewalls
 - a. Firewall efficacy
 - b. Basic firewall types
- 7. Security Policy Design Issues

Quick Quiz

1. What are the different techniques you can use to authenticate a user?

Passwords, badges, finger prints, voice prints, face prints, retina scan and iris print, to name a few.

2. What are the basic parts of an encryption system?

Plaintext, the encryption algorithm, the key, the ciphertext.

3. How can a digital certificate be used?

It can be assigned to a document so that the owner can later verify ownership.

4. What are the basic ingredients of public key infrastructure?

Encryption techniques, digital certificates, certificate authorities, public key generation, storage, and management.

Network Design and Management

Chapter 14

Learning Objectives

- Recognize the systems development life cycle and define each of its phases.
- Explain the importance of creating one or more connectivity maps.
- Outline the differences between technical, financial, operational, and time feasibility.
- Create a cost-benefit analysis incorporating the time value of money.
- Explain why performing capacity planning and traffic analysis is difficult.
- Describe the steps involved in performing a baseline study.
- Discuss the importance of a network manager and the skills required of that position.
- Calculate component and system reliability and availability.
- Recognize the basic hardware and software network diagnostic tools.
- Describe the importance of a help desk with respect to managing network operations.
- List the main features of the Simple Network Management Protocol (SNMP) and distinguish between a manager and an agent.
- Describe the use of the Remote Network Monitoring (RMON) protocol and its relationship to SNMP.

Chapter Outline

2. Systems Development Life Cycle
 - a. Planning phase
 - b. Analysis phase
 - c. Design phase
 - d. Implementation phase
 - e. Maintenance phase
3. Network Modeling
 - a. Wide area connectivity map
 - b. Metropolitan area connectivity map
 - c. Local area connectivity map
4. Feasibility Studies

5. Capacity Planning
6. Creating a Baseline
7. Network Manager Skills
8. Generating Useable Statistics
9. Managing Operations
 - a. Simple Network Management Protocol (SNMP)
10. Network Diagnostic Tools
 - a. Tools that test and debug network hardware
 - b. Tools that analyze data transmitted over the network
 - c. Managing operations
 - d. Simple Network Management Protocol (SNMP)

Quick Quiz

1. Why should you know how to design a network?

You may have to assist a systems analyst in planning a new network or modification to an existing network. You may be called upon to design or upgrade a network by yourself.

2. What functions of the SDLC model relate directly to network design?

Feasibility studies, cost-benefit analysis, capacity planning, traffic analysis, baselining, and network modeling.

3. What is Simple Network Management Protocol (SNMP)?

SNMP is a protocol that allows a network manager to manage network components from a single location. Many types of devices, such as hubs, bridges, routers, switches, and servers contain SNMP support.