

*Fundamentals of*  
**Business Data Communications**  
10<sup>th</sup> Edition

Jerry FitzGerald AND Alan Dennis

**INTERNATIONAL STUDENT VERSION**

TENTH EDITION

# FUNDAMENTALS OF BUSINESS DATA COMMUNICATIONS

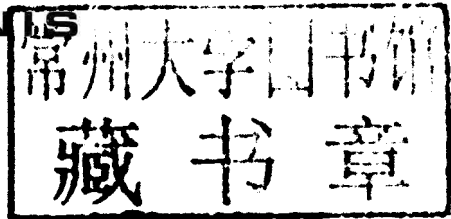
International Student Version

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## *To Kelly and Alec*

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# PREFACE

Over the past few years, many fundamental changes have occurred in data communications and networking that will shape the future for decades to come. Networking applications such as the Internet and World Wide Web have exploded into the business world. High-speed modems providing megabit data rates (millions of bits per second) over regular telephone lines and cable TV circuits are widely available. New local area network (LAN) and backbone technologies providing gigabit (billions of bits per second) speeds are now available. Metropolitan area network (MAN) and wide area network (WAN) technologies providing terabit (trillions of bits per second) to petabit (quadrillions of bits per second) speeds are on the horizon. The integration of voice and data communication is moving rapidly.

Perhaps the most important change has been the recognition of the strategic importance of communications and networking in both the public and private sector. Today, almost all computers are networked. As we look back on the 1990s, we realize that the importance of the computer was surpassed by the importance of the network.

## PURPOSE OF THIS BOOK

Our goal is to combine the fundamental concepts of data communications and networking with practical applications. Although technologies and applications change rapidly, the fundamental concepts evolve much more slowly; they provide the foundation from which new technologies and applications can be understood, evaluated, and compared.

This book has two intended audiences. First and foremost, it is a university textbook. Each chapter introduces, describes, and then summarizes fundamental concepts and applications. Management Focus boxes highlight key issues and describe how networks are actually being used today. Technical Focus boxes highlight key technical issues and provide additional detail. Mini case studies at the end of each chapter provide the opportunity to apply these technical and management concepts. Moreover, the text is accompanied by a detailed Instructor's Manual that provides additional background information, teaching tips, and sources of material for student exercises, assignments, and exams. Finally, our Web page will continue to update the book.

Second, this book is intended for the professional who works in data communications and networking. The book has many detailed descriptions of the technical aspects of communications, along with illustrations where appropriate. Moreover, managerial, technical, and sales personnel can use this book to gain a better understanding of fundamental concepts and trade-offs not presented in technical books or product summaries.

## WHAT'S NEW IN THIS EDITION

The tenth edition has five major changes from the ninth edition. First, it includes numerous updates to technologies that have evolved and changed since the last edition went to press. The biggest change has been to the chapter on wireless LANs, as this has undergone major changes in just 2 years.

Second, we have added new hands-on activities to each chapter. The activities are designed to reinforce the key concepts in each chapter, as well as to provide an interesting, practical use of network technology. These activities could be used as demonstrations in class, lab exercises, or activities given as homework. In any event, we believe they will help students better understand key concepts.

Third, this edition includes updates to examples, questions, and exercises throughout the book. We believe these items help to improve students' understanding of key topics. We've also revised three crossword puzzles to the book because we've found that students enjoy puzzles, even those that help them learn.

Fourth, the chapter on network security has been reorganized and updated. This edition focuses on the two major aspects of security (business continuity and intrusion prevention) as well as risk analysis. The topics within the two major aspects have been reorganized to make them easier to understand and easier to teach.

Finally, what is just as important as what has been added is what has been removed. As new technologies arrive it is important to reduce complexity and bulk by removing older technologies that are fading from use. This edition has omitted legacy technologies such as ATM in the backbone, and has reduced the coverage of dial-up modems in favor of cable modems and DSL modems.

### Online Animations [www.wiley.com/go/global/fitzgerald](http://www.wiley.com/go/global/fitzgerald)

For students and instructors, we're offering online animations that help students visualize basic data communications processes. These animations can be used in the classroom or as a study aid for students. To access the animations, go to the Student Resources site.

### Lab Exercises [www.wiley.com/go/global/fitzgerald](http://www.wiley.com/go/global/fitzgerald)

This edition includes an online lab manual with many hands-on exercises that can be used in a networking lab. These exercises include configuring routers and servers and other additional practical topics. This edition also includes a series of OPNET labs; OPNET is a network simulation tool.

## **Online Supplements for Instructors** **[www.wiley.com/go/global/fitzgerald](http://www.wiley.com/go/global/fitzgerald)**

Instructor's supplements include an Instructor's Manual that includes teaching tips, war stories and answers to end of chapter questions and Lecture Slides in PowerPoint for classroom presentations. Both are available to instructors adopting this text.

## **ACKNOWLEDGMENTS**

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# BRIEF CONTENTS

## **PART ONE INTRODUCTION 1**

Chapter 1 Introduction 2

## **PART TWO FUNDAMENTAL CONCEPTS 37**

Chapter 2 Network Applications 38

Chapter 3 Circuits and Transmission 75

Chapter 4 Data Link Layer 117

Chapter 5 TCP/IP 146

## **PART THREE NETWORK TECHNOLOGIES 197**

Chapter 6 Ethernet 198

Chapter 7 Wireless LANs 229

Chapter 8 Backbones 260

Chapter 9 Wide Area Networks 293

Chapter 10 The Internet 336

## **PART FOUR NETWORK MANAGEMENT 365**

Chapter 11 Security 366

Chapter 12 Designing Networks 434

Chapter 13 Network Administration 471

## **PART FIVE APPENDICES 505**

Appendix A Connector Cables 506

Appendix B Spanning Tree Protocol 517

Appendix C IP Telephony 521

Appendix D Cellular Technologies 524

Appendix E TCP/IP Game 526

Appendix F Windows Server 537

Glossary 549

Index 579

---

# CONTENTS

## PART ONE

### INTRODUCTION 1

---

#### CHAPTER 1

##### INTRODUCTION 2

##### INTRODUCTION 4

- A Brief History of Communications in North America 5

- A Brief History of Information Systems 8

- A Brief History of the Internet 9

##### DATA COMMUNICATIONS NETWORKS 11

- Components of a Network 12

- Types of Networks 12

##### NETWORK MODELS 15

- Open Systems Interconnection Reference Model 16

- Internet Model 18

- Message Transmission Using Layers 19

##### NETWORK STANDARDS 22

- The Importance of Standards 22

- The Standards-Making Process 22

- Common Standards 25

##### FUTURE TRENDS 26

- Pervasive Networking 26

- The Integration of Voice, Video, and Data 28

- New Information Services 29

##### IMPLICATIONS FOR MANAGEMENT 30

##### SUMMARY 31

## PART TWO

### FUNDAMENTAL CONCEPTS 37

---

#### CHAPTER 2

##### NETWORK APPLICATIONS 38

##### INTRODUCTION 40

##### APPLICATION ARCHITECTURES 40

- Host-Based Architectures 41

- Client-Based Architectures 42

- Client-Server Architectures 43

- Peer-to-Peer Architectures 147

- Choosing Architectures 47

##### WORLD WIDE WEB 49

- How the Web Works 49

- Inside an HTTP Request 50

- Inside an HTTP Response 51

##### ELECTRONIC MAIL 53

- How E-mail Works 54

- Inside an SMTP Packet 58

- Listserv Discussion Groups 59

- Attachments in Multipurpose Internet Mail Extension 59

##### OTHER APPLICATIONS 60

- File Transfer Protocol 60

- Telnet 61

- Instant Messaging 62

- Videoconferencing 63

##### IMPLICATIONS FOR MANAGEMENT 65

##### SUMMARY 66

---

#### CHAPTER 3

##### CIRCUITS AND TRANSMISSION 75

##### INTRODUCTION 77

##### CIRCUITS 78

- Circuit Configuration 78

- Data Flow 79

- Multiplexing 80

- How DSL Transmits Data 86

COMMUNICATION MEDIA	87
Guided Media	87
Wireless Media	90
Media Selection	94
DIGITAL TRANSMISSION OF DIGITAL DATA	95
Coding	95
Transmission Modes	96
Digital Transmission	98
How Ethernet Transmits Data	99
ANALOG TRANSMISSION OF DIGITAL DATA	99
Modulation	100
Capacity of a Circuit	103
How Modems Transmit Data	104
DIGITAL TRANSMISSION OF ANALOG DATA	104
Translating from Analog to Digital	105
How Telephones Transmit Voice Data	106
How Instant Messenger Transmits Voice Data	107
Voice over Internet Protocol [VoIP]	108
IMPLICATIONS FOR MANAGEMENT	109
SUMMARY	110

## CHAPTER 4

### DATA LINK LAYER 117

INTRODUCTION	119
MEDIA ACCESS CONTROL	119
Controlled Access	120
Contention	120
Relative Performance	121
ERROR CONTROL	121
Sources of Errors	122
Error Prevention	124
Error Detection	125
Error Correction via Retransmission	127
Forward Error Correction	129
Error Control in Practice	129
DATA LINK PROTOCOLS	130
Asynchronous Transmission	130
Synchronous Transmission	132
TRANSMISSION EFFICIENCY	135
IMPLICATIONS FOR MANAGEMENT	139
SUMMARY	139

## CHAPTER 5

### TCP/IP 146

INTRODUCTION	148
--------------	-----

TRANSPORT AND NETWORK	
LAYER PROTOCOLS	149
Transmission Control Protocol [TCP]	150
Internet Protocol [IP]	150
TRANSPORT LAYER FUNCTIONS	152
Linking to the Application Layer	152
Segmenting	153
Session Management	155
ADDRESSING	157
Assigning Addresses	158
Address Resolution	162
ROUTING	164
Types of Routing	166
Routing Protocols	168
Multicasting	172
TCP/IP EXAMPLE	173
Known Addresses, Same Subnet	176
Known Addresses, Different Subnet	177
Unknown Addresses	178
TCP Connections	179
TCP/IP and Network Layers	179
IMPLICATIONS FOR MANAGEMENT	182
SUMMARY	182

# PART THREE

## NETWORK TECHNOLOGIES 197

## CHAPTER 6

### ETHERNET 198

INTRODUCTION	200
Why Use a LAN?	200
Dedicated-Server versus Peer-to-Peer LANs	201
LAN COMPONENTS	203
Network Interface Cards	203
Network Cables	203
Network Hubs and Switches	204
Network Operating Systems	206
TRADITIONAL ETHERNET [IEEE 802.3]	209
Topology	209
Media Access Control	210
Types of Ethernet	212
SWITCHED ETHERNET	213
Topology	214
Media Access Control	215

Performance Benefits	216
THE BEST PRACTICE LAN DESIGN	216
IMPROVING LAN PERFORMANCE	217
Improving Server Performance	218
Improving Circuit Capacity	219
Reducing Network Demand	221
IMPLICATIONS FOR MANAGEMENT	221
SUMMARY	222

---

## CHAPTER 7

<b>WIRELESS LANs</b>	<b>229</b>
INTRODUCTION	231
WLAN COMPONENTS	231
Network Interface Cards	232
Access Points	232
Radio Frequencies	234
WI-FI	236
Topology	236
Media Access Control	236
Types of Wi-Fi	239
Wi-Fi as Public Internet Access	241
WIMAX	241
Topology	241
Media Access Control	241
Types of WiMAX	241
BLUETOOTH	242
Topology	243
Media Access Control	243
THE BEST PRACTICE WLAN DESIGN	243
Recommendations	244
Physical WLAN Design	244
WLAN Security	248
IMPROVING WLAN PERFORMANCE	249
Improving Device Performance	249
Improving Circuit Capacity	250
Reducing Network Demand	251
IMPLICATIONS FOR MANAGEMENT	252
SUMMARY	253

---

## CHAPTER 8

<b>BACKBONES</b>	<b>260</b>
INTRODUCTION	261
BACKBONE NETWORK COMPONENTS	262
Switches	262
Routers	262

Gateways	264
A Caution	266
BACKBONE NETWORK ARCHITECTURES	266
Backbone Architecture Layers	266
Switched Backbones	267
Routed Backbones	273
Virtual LANs	273
THE BEST PRACTICE BACKBONE DESIGN	282
IMPROVING BACKBONE PERFORMANCE	284
Improving Computer and Device Performance	284
Improving Circuit Capacity	285
Reducing Network Demand	285
IMPLICATIONS FOR MANAGEMENT	286
SUMMARY	286

---

## CHAPTER 9

<b>WIDE AREA NETWORKS</b>	<b>293</b>
INTRODUCTION	295
CIRCUIT-SWITCHED NETWORKS	296
Basic Architecture	296
Plain Old Telephone Service	297
ISDN	298
DEDICATED-CIRCUIT NETWORKS	299
Basic Architecture	299
T Carrier Services	304
Synchronous Optical Network	304
PACKET-SWITCHED NETWORKS	305
Basic Architecture	306
X.25	309
Asynchronous Transfer Mode	309
Frame Relay	310
Ethernet Services	311
VIRTUAL PRIVATE NETWORKS	312
Basic Architecture	312
VPN Types	314
How VPNs Work	314
THE BEST PRACTICE MAN/WAN DESIGN	318
IMPROVING MAN/WAN PERFORMANCE	321
Improving Device Performance	321
Improving Circuit Capacity	321
Reducing Network Demand	322
IMPLICATIONS FOR MANAGEMENT	323
SUMMARY	324

---

**CHAPTER 10****THE INTERNET 336****INTRODUCTION 337****HOW THE INTERNET WORKS 338**

Basic Architecture 338

Connecting to an ISP 339

The Internet Today 342

**INTERNET ACCESS TECHNOLOGIES 343**

DSL 344

Cable Modems 346

Fixed Wireless 348

Mobile Wireless 350

Future Technologies 351

**INTERNET GOVERNANCE 352****INTERNET2 354****IMPLICATIONS FOR MANAGEMENT 356****SUMMARY 357**

---

**PART FOUR****NETWORK MANAGEMENT  
365**

---

**CHAPTER 11****SECURITY 366****INTRODUCTION 367**

Why Networks Need Security 369

Types of Security Threats 370

Network Controls 370

**RISK ASSESSMENT 373**

Develop a Control Spreadsheet 373

Identify and Document the Controls 377

Evaluate the Network's Security 378

**ENSURING BUSINESS CONTINUITY 379**

Virus Protection 379

Denial-of-Service Protection 380

Theft Protection 383

Device Failure Protection 384

Disaster Protection 385

**INTRUSION PREVENTION 389**

Security Policy 390

Perimeter Security and Firewalls 390

Server and Client Protection 398

Encryption 403

User Authentication 410

Preventing Social Engineering 413

Intrusion Prevention Systems 415

Intrusion Recovery 417

**BEST PRACTICE RECOMMENDATIONS 418****IMPLICATIONS FOR MANAGEMENT 419****SUMMARY 420**

---

**CHAPTER 12****DESIGNING NETWORKS 434****INTRODUCTION 436**

The Traditional Network Design Process 436

The Building-Block Network Design Process 437

**NEEDS ANALYSIS 439**

Geographic Scope 440

Application Systems 441

Network Users 442

Categorizing Network Needs 443

Deliverables 443

**TECHNOLOGY DESIGN 444**

Designing Clients and Servers 445

Designing Circuits and Devices 445

Network Design Tools 446

Deliverables 447

**COST ASSESSMENT 448**

Request for Proposal 448

Selling the Proposal to Management 449

Deliverables 450

**DESIGNING FOR NETWORK PERFORMANCE 450**

Managed Networks 450

Network Circuits 455

Network Devices 456

Minimizing Network Traffic 459

**IMPLICATIONS FOR MANAGEMENT 463****SUMMARY 464**

---

**CHAPTER 13****NETWORK ADMINISTRATION 471****INTRODUCTION 473****ORGANIZING THE NETWORK****MANAGEMENT FUNCTION 473**

The Shift to LANs and the Internet 473

Integrating LANs, WANs, and the Internet 474

Integrating Voice and Data Communications 475

**CONFIGURATION MANAGEMENT 477**

Configuring the Network and Client Computers	477
Documenting the Configuration	478
PERFORMANCE AND FAULT MANAGEMENT	479
Network Monitoring	480
Failure Control Function	482
Performance and Failure Statistics	485
Improving Performance	488
END USER SUPPORT	489
Resolving Problems	489
Providing End User Training	490
COST MANAGEMENT	490
Sources of Costs	491
Reducing Costs	494
IMPLICATIONS FOR MANAGEMENT	496
SUMMARY	496

APPENDIX C	IP TELEPHONY	521
APPENDIX D	CELLULAR TECHNOLOGIES	524
APPENDIX E	TCP/IP GAME	526
APPENDIX F	WINDOWS SERVER	537
GLOSSARY		549
INDEX		579

## **PART FIVE**

### **APPENDICES 505**

APPENDIX A	CONNECTOR CABLES	506
APPENDIX B	SPANNING TREE PROTOCOL	517

## PART ONE

# INTRODUCTION



Network equipment from Cisco Systems, Inc.

Courtesy Cisco Systems, Inc.

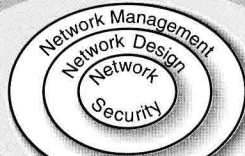
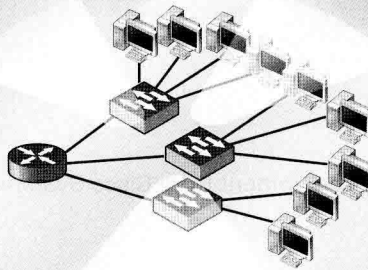
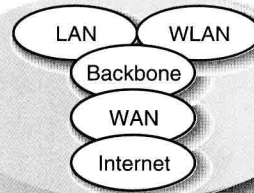
# CHAPTER 1

## INTRODUCTION

### Fundamental Concepts

Application Layer
Transport Layer
Network Layer
Data Link Layer
Physical Layer

### Network Technologies



### Network Management

## The Three Faces of Networking

**T HIS CHAPTER** introduces the basic concepts of data communications and shows how we have progressed from paper-based systems to modern computer networks. It begins by describing why it is important to study data communications and how the invention of the telephone, the computer, and the Internet has transformed the way we communicate. Next, the basic types and components of a data communication network are discussed. The importance of a network model based on layers and the importance of network standards are examined. The chapter concludes with an overview of three key trends in the future of networking.

## OBJECTIVES ▼

- Be aware of the history of communications, information systems, and the Internet
- Be aware of the applications of data communication networks
- Be familiar with the major components of and types of networks
- Understand the role of network layers
- Be familiar with the role of network standards
- Be aware of three key trends in communications and networking

## CHAPTER OUTLINE ▼

### INTRODUCTION

- A Brief History of Communications in North America
- A Brief History of Information Systems
- A Brief History of the Internet

### DATA COMMUNICATIONS NETWORKS

- Components of a Network
- Types of Networks

### NETWORK MODELS

- Open Systems Interconnection Reference Model
- Internet Model

### Message Transmission Using Layers

### NETWORK STANDARDS

- The Importance of Standards
- The Standards-Making Process
- Common Standards

### FUTURE TRENDS

- Pervasive Networking
- The Integration of Voice, Video, and Data
- New Information Services

### IMPLICATIONS FOR MANAGEMENT

### SUMMARY