

---

**BROADBAND  
COMMUNICATIONS  
AND  HOME  
NETWORKING**

---

**SCOTT R. BULLOCK**

# Contents

## Introduction i

## Basic Principles of Telephony 1

1.1	History	1
1.2	Telephony Fundamentals	2
1.3	Basic Telephone Design	8
1.4	Three Types of Exchanges	10
1.5	Modems	11
1.6	T Carrier Systems	13
1.7	Personal Communications Services (PCS)	14
1.8	Cellular Telephone	16
1.9	Industrial, Scientific, Medical ISM Bands	16
1.10	Summary	17
1.11	References	17

## High-Speed Modems 19

2.1	Integrated Services Digital Network	19
2.2	Digital Subscriber Loop	20
2.3	Asymmetric Digital Subscriber Loop (ADSL)	25
2.4	High-Speed Digital Subscriber Loop (HDSL)	28
2.5	Very High-Speed Digital Subscriber Loop (VDSL)	28
2.6	Cable Modems	29
2.7	Video Standards	30
2.8	Summary	31
2.9	References	31

## Digital Modulation Techniques 33

3.1	Phase-Shift Keying (PSK)	33
3.2	Frequency Shift Keying (FSK)	43
3.3	Multiple Users	45
3.4	Parallel Techniques to Increase Data Rates	47
3.5	Orthogonal Frequency Division Multiplexing (OFDM)	47
3.6	Spread Spectrum Systems	48
3.7	Summary	49
3.8	References	49

## **Application and Uses for Orthogonal Signals 51**

4.1	Quadrature Sine/Cosine Signals	52
4.2	Orthogonalizer Techniques	57
4.3	Orthogonal Frequency Division Multiplexing (OFDM)	60
4.4	Summary	63
4.5	References	63

## **Networking for Home and Small Office 65**

5.1	Local Area Networks (LAN)	65
5.2	LAN Standards	68
5.3	Fiber-Distributed Data Interface	69
5.4	Universal Serial Bus (USB)	69
5.5	Cable Networks	70
5.6	Network Layers	70
5.6	Summary	72
5.7	References	72

## **Power Line Communications 75**

6.1	Communication Over the Power Lines	76
6.2	Power Line Modulation	79
6.3	The Power Line Infrastructure	80
6.4	Advantages and Disadvantages Using Power Line Communications	81
6.5	Summary	82
6.6	References	82

## **Telephone Line Communications 85**

7.1	Communications Over the Telephone Line	85
7.2	Telephone Line Modulation	86
7.3	Telephone Line Standards	86
7.4	The Telephone Line Infrastructure	87
7.5	Advantages and Disadvantages Using the Telephone Lines	87
7.6	Summary	89
7.7	References	90

## **Radio Frequency Communications 91**

8.1	Basic RF Systems	92
8.2	Networking Standards for RF Systems	98
8.3	Summary	106
8.4	References	106

<b>The “Last Mile”</b>	<b>109</b>
9.1	Types of Transmission Mediums . . . . . 109
9.2	Telephone Wire . . . . . 110
9.3	Coaxial Cable . . . . . 110
9.4	Fiber Optics . . . . . 111
9.5	Wireless and Radio Frequency . . . . . 112
9.6	Local Multipoint Distribution Service (LMDS) . . . . . 113
9.7	Microwave (or Multichannel) Multipoint Distribution Service (MMDS) . . . . . 117
9.8	Standards for LMDS and MMDS . . . . . 118
9.9	Satellite Communications . . . . . 118
9.10	Summary . . . . . 119
9.11	References . . . . . 120

<b>Satellite Communications</b>	<b>121</b>
10.1	Communication Satellites . . . . . 121
10.2	General Satellite Operation . . . . . 122
10.3	Fixed Satellite Service . . . . . 125
10.4	Geostationary Orbits . . . . . 125
10.5	Ground Station Antennas . . . . . 126
10.6	Noise and the Low-Noise Amplifier . . . . . 128
10.7	The Link Budget . . . . . 132
10.8	Multiple Channels in the Same Frequency Band . . . . . 138
10.9	Multiple Access Schemes . . . . . 138
10.10	Propagation Delay . . . . . 139
10.11	Cost . . . . . 139
10.12	Regulations . . . . . 140
10.13	Types of Satellites Used for Communications . . . . . 140
10.14	System Design for Satellite Communications . . . . . 140
10.15	Summary . . . . . 141
10.16	References . . . . . 141