

Table of Contents

Introduction.....	xi
Chapter 1: Fundamentals of Wireless Communication	1
1.1 Introduction to Wireless Communication.....	2
1.1.1 Advantages of Wireless Communication.....	2
1.1.2 Limitations of Wireless Communication.....	3
1.1.3 Applications of Wireless Communication.....	4
1.2 Wireless Media.....	7
1.2.1 Sensor.....	7
1.2.2 Mobile Phones or Smartphones	8
1.2.3 PDA.....	9
1.2.4 Pocket Computer.....	9
1.2.5 Notebook/Laptop.....	10
1.3 Frequency Spectrum	11
1.4 Radio and Infrared Frequency Spectrum	13
1.5 Infrared Modulation Techniques	13
1.5.1 Digital Baseband Modulation Techniques.....	14
1.5.2 Subcarrier Intensity Modulation Technique.....	15
1.6 Spread Spectrum.....	16
1.7 Frequency Hopping Spread Spectrum.....	17
1.8 Direct Sequence Spread Spectrum	18
1.9 Multiple Access Techniques	19
1.9.1 Frequency Division Multiple Access	20
1.9.2 Time Division Multiple Access.....	20
1.9.3 Code Division Multiple Access	21
1.9.4 Carrier Sense Multiple Access.....	21
1.9.5 Orthogonal Frequency Division Multiple Access (OFDMA).....	22
Summary.....	23
Review Exercise	24
Multiple Choice Questions.....	24
Subjective Questions.....	25
Solved Previous Years' Questions.....	32

Chapter 2: Wireless Technology.....	39
2.1 Introduction to Cellular Concepts.....	40
2.1.1 Frequency Reuse.....	41
2.1.2 Channel Assignment Strategies.....	42
2.1.3 Handoff Strategies.....	42
2.1.4 Interference and System Capacity.....	45
2.2 Evolution of Cellular Networks.....	48
2.2.1 First Generation.....	48
2.2.2 Second Generation.....	49
2.2.3 Third Generation.....	49
2.2.4 Fourth Generation.....	50
2.2.5 Fifth Generation.....	51
2.3 Global System for Mobile Communications (GSM).....	52
2.3.1 GSM System Architecture.....	52
2.3.2 Radio Subsystem.....	56
2.3.3 Types of Channels.....	57
2.3.4 GSM Burst Structures.....	58
2.3.5 GSM Frame Structure.....	59
2.4 GPRS.....	60
2.5 EDGE.....	64
2.6 CDMA.....	65
2.6.1 Architecture.....	66
2.6.2 Frequency and Channel Specifications.....	67
2.6.3 Forward CDMA Channel.....	68
2.6.4 Reverse CDMA Channel.....	68
2.7 Comparison Between GSM and CDMA.....	69
Summary.....	69
Review Exercise.....	70
Multiple Choice Questions.....	70
Subjective Questions.....	71
Solved Previous Years' Questions.....	81
Chapter 3: Wireless in Local Loop.....	83
3.1 Requirements of a WLL System.....	85
3.2 Advantages of WLL Systems.....	85

3.3	Public-Switched Telephone Network.....	86
3.3.1	Hierarchy of PSTN.....	87
3.3.2	Access and Transmission Facilities	88
3.3.3	Central Office	90
3.4	WLL System Architecture	92
3.5	Multichannel Multipoint Distribution Service	93
3.5.1	MMDS Architecture and Its Working.....	93
3.5.2	Advantages of MMDS.....	94
3.6	Local Multipoint Distribution Service.....	95
3.6.1	Advantages and Limitations of LMDS.....	96
3.7	WLL Subscriber Terminal.....	96
3.8	WLL Interface to PSTN.....	96
3.9	Limitations of WLL Systems.....	97
3.10	Wireless Local Loop Technologies.....	98
3.11	Cellular Systems.....	98
3.12	Satellite Systems	100
	Summary.....	101
	Review Exercise	102
	Multiple Choice Questions.....	102
	Subjective Questions.....	103
	Solved Previous Years' Questions.....	113

Chapter 4: Wireless Local Area Network 115

4.1	Features and Disadvantages of WLAN.....	116
4.2	Types of WLANs.....	116
4.2.1	Infrastructure-Based Wireless Networks	116
4.2.2	Ad Hoc Wireless Networks.....	117
4.3	WLAN Equipment	118
4.4	WLAN Topologies	120
4.4.1	Basic Service Set	120
4.4.2	Extended Service Set.....	122
4.5	WLAN Technologies.....	123
4.5.1	Infrared	123
4.5.2	Ultra High Frequency (Narrowband) Radios.....	124
4.5.3	Spread Spectrum Radios.....	125

4.6	IEEE 802.11 WLAN.....	125
4.7	IEEE 802.11 WLAN Architecture.....	126
4.7.1	IEEE 802.11 Physical Layer.....	127
4.7.2	IEEE 802.11 Data Link Layer.....	130
4.8	Wireless Security Offered by IEEE 802.11.....	142
4.8.1	Authentication in IEEE 802.11.....	142
4.8.2	Encryption in IEEE 802.11.....	143
4.9	Latest Developments in IEEE 802.11 Standards.....	145
	Summary.....	146
	Review Exercise.....	146
	Multiple Choice Questions.....	146
	Subjective Questions.....	148
	Solved Previous Years' Questions.....	160

Chapter 5: Wireless Personal Area Networks..... 165

5.1	WPAN Architecture.....	166
5.1.1	Piconet.....	168
5.1.2	Scatternet.....	169
5.2	WPAN Technologies and Protocols.....	170
5.2.1	Bluetooth.....	171
5.2.2	Protocol.....	173
5.3	HR WPAN.....	177
5.4	LR WPAN (ZigBee).....	178
5.4.1	Star Topology.....	179
5.4.2	Mesh Topology.....	179
5.4.3	Tree Topology.....	180
5.4.4	ZigBee Stack Architecture.....	181
5.5	Wireless Sensor Networks.....	182
5.5.1	Network Model.....	182
5.5.2	Protocol Stack.....	184
5.5.3	Routing Algorithm.....	184
5.5.4	Wireless Sensor Network Applications.....	185

Summary.....	187
Review Exercise	187
Multiple Choice Questions.....	187
Subjective Questions.....	188
Solved Previous Years' Questions.....	198
Chapter 6: Wireless Metropolitan Area	211
6.1 Overview of WMAN.....	212
6.2 IEEE 802.16.....	213
6.2.1 Protocol Architecture.....	216
6.3 IEEE 802.16a.....	218
6.3.1 WiMAX and the IEEE 802.16a PHY Layer	220
6.3.2 IEEE 802.16a MAC Layer	221
6.4 WiMAX and LTE/3GPP Comparison.....	222
6.5 IEEE 802.20.....	224
6.5.1 IEEE 802.20 PHY Layer.....	224
6.5.2 IEEE 802.20 MAC Layer.....	225
Summary.....	225
Review Exercise.....	226
Multiple Choice Questions.....	226
Subjective Questions.....	227
Solved Previous Years' Questions.....	233
Chapter 7: Security Issues in Wireless Systems.....	235
7.1 Need for Security in Wireless Systems	236
7.2 Wireless Attacks or Security Issues	236
7.2.1 Network Security Issues	237
7.2.2 Device Security Issues	239
7.3 Security Services	241
7.4 Wired Equivalent Privacy Protocol.....	243
7.5 Mobile IP.....	246
7.6 Virtual Private Network.....	249
7.6.1 Point-to-Point Tunneling Protocol.....	250
7.6.2 Layer 2 Tunneling Protocol.....	250
7.6.3 IPSec	251

x ► Table of Contents

7.7	Security in WPAN.....	252
7.7.1	Bluetooth.....	252
7.7.2	ZigBee.....	255
7.8	Security Using SIM.....	256
7.9	GSM Privacy and Authentication.....	256
	Summary.....	258
	Review Exercise.....	258
	Multiple Choice Questions.....	258
	Subjective Questions.....	260
	Solved Previous Years' Questions.....	265
Chapter 8: Economics of Wireless Networks.....		275
8.1	Economic Benefits of Wireless Networks.....	275
8.2	Economics of the Wireless Industry.....	276
8.2.1	Mobile Terminal Manufacturers.....	276
8.2.2	Role Played by Government Agencies in the Wireless Industry.....	277
8.2.3	Infrastructure Manufacturers.....	280
8.2.4	Mobile Carriers.....	280
8.3	Wireless Data Forecast.....	282
8.3.1	Data-Demanding Applications.....	283
8.3.2	Technological Alternatives and Their Economics.....	284
8.4	Charging Issues.....	285
8.4.1	Mobility Charges.....	286
8.4.2	Roaming Charges.....	288
8.4.3	Billing: Contracts versus Prepaid Time.....	289
8.4.4	Charging.....	290
	Summary.....	293
	Review Exercise.....	293
	Multiple Choice Questions.....	293
	Subjective Questions.....	295
	Solved Previous Years' Questions.....	305
Lab.....		307
Index.....		355