McGRAW-HILL PROFESSIONAL ENGINEERING

3G Wireless with WiMAX and Wi-Fi

802.16 AND 802.11

- ✔ Convergence of Cellular and WiFi/WiMAX
- ✔ CDMA2000 (1xRTT, 1xEVDO, 1xEDV)
- ✔ GSM/GPRS/EDGE/UMTS (WCDMA)
- ✔ WiFi Configurations
- ✔ Fourth Generation Mobility (4G)

Clint Smith
John Meyer

Contents

Preface xi

Chapter 1. Introduction 1

1.1 Cellular Concept 2
1.2 Generic Wireless System Configuration 4
1.3 Handoffs 8
1.4 Typical Central Office (CO) 9
1.5 Generic Cell Site Configuration 10
1.6 Frequency Reuse 12
1.7 IMT-2000 12
1.8 Bluetooth 14
1.9 WAP 15
1.10 WLL 16
1.11 LMDS 18
1.12 MMDS, MDS, and IFTS 20
1.13 XDSL 21
1.14 Cable Systems 23
1.15 VoIP 23
1.16 Mobile Data (IP) 25
1.17 Wireless LAN (802.11) 26

Chapter 2. Radio System 29

2.1 RF Design Process 30
2.2 Radio System 33
2.3 Propagation Model 36
2.4 Path Clearance 38
2.5 Link Budget 41
2.6 FDD and TDD 43
2.7 Antennae 45
2.8 ERP and EIRP 46
2.9 Modulation 46

2.10 Orthogonal Frequency Division Multiplexing (OFDM) 50
2.11 Frequency Planning 51
2.12 Inbuilding and Tunnel Systems 57
2.13 Planning 60
2.14 Intelligent Antennae 61

Chapter 3. Network Design 65

3.1 Service Treatments 66
3.2 TDM/IP/ATM Considerations 67
3.3 TDM Switching 68
3.4 Switching Functions 69
3.5 Circuit Switches 70
3.5.1 Space-division switching 70
3.5.2 Time-division switching 71
3.6 Circuit Switching Hierarchy 72
3.7 Packet Switching 72
3.8 IP Networks 74
3.9 IP Addressing 75
3.10 Soft-Switch 78
3.11 ATM 80
3.11.1 ATM networks 83
3.11.2 ATM design aspects 85
3.12 Facility Sizes 87
3.13 Demand Estimation 87
3.14 VoIP 89
3.15 OSI Levels 90

Chapter 4. Mobile Wireless Systems 93

4.1 IMT-2000 94
4.2 Wireless Mobility Platforms 95
4.3 CDMA2000 (1xRTT, 1xEVDO, 1xEDV) 100
4.3.1 CDMA radio network 101
4.3.2 Packet data serving node (PSDN) 102
4.3.3 RAN 103
4.3.4 BTS 104
4.3.5 Call and data processing 107
4.3.6 Handoffs 116
4.4 GSM 118
4.4.1 GSM RAN 121
4.4.2 Location update 121
4.4.3 Mobile-originated voice call 123
4.4.4 Mobile-terminated voice call 123
4.4.5 Handover 123
4.5 GPRS 126
4.5.1 GPRS packet data rates 126
4.5.2 GPRS devices 128
4.5.3 GPRS air interface 128
4.5.4 GPRS network architecture 129
4.5.5 GPRS attach 131
4.5.6 Establishing a PDP context 131

4.6 Enhanced Data Rates for Global Evolution (EDGE) 131
4.7 Universal Mobile Telecommunications Service (UMTS) 134
4.7.1 Channel types 136
4.7.2 UTRAN architecture 139
4.7.3 Call flow diagram 141
4.7.4 UMTS packet data 141
4.7.5 UMTS core network 143

Chapter 5. 802.11 147

5.1 Wireless LANs 147
5.2 802 Standard 148
5.3 802.11 Objectives 148
5.4 Wi-Fi 150
5.4.1 802.11b 151
5.4.2 802.11g 151
5.4.3 802.11a 151
5.4.4 Comparison of 802.11a, 802.11b and 802.11g 152
5.5 Frequency Allocation 152
5.5.1 802.11b and 802.11g 152
5.5.2 802.11a 152
5.6 Modulation and Coding Schemes 152
5.6.1 802.11b 153
5.6.2 802.11g and 8021.11a 154
5.7 Network Architecture 154
5.7.1 Basic elements of the 802.11 standard 154
5.7.2 Network components 155
5.8 Typical Wi-Fi Configurations 156
5.8.1 SOHO Wi-Fi Network 157
5.8.2 Enterprise application 159
5.8.3 Campus deployment 161
5.9 802.11 Services 162
5.10 Hot Spots 163
5.10.1 Access methods 164
5.10.2 Security at Hot Spots 165
5.11 Security 165
5.11.1 WEP 165
5.11.2 Encryption with WEP 166
5.11.3 Alternatives to WEP 166
5.11.4 SSID 166
5.11.5 MAC address 167
5.11.6 Extensible authentication protocol (EAP) 167
5.12 Firewalls and Virtual Private Networks 167
5.12.1 Proprietary vendor solutions 168
5.13 Mobile VPN 168
5.13.1 Advantage to using VPNs 168
5.13.2 Increased security and control of users 169
5.13.3 Cost and maintenance 169
5.13.4 PSTN costs 169
5.14 Flavors of VPN 169
5.14.1 Voluntary VPNs 169
5.14.2 Compulsory VPN 170
5.14.3 Chained VPN 170
5.15 Mobility 171

5.15.1 Mobile VPN implementation in CDMA2000 networks 171
5.15.2 Voluntary VPNs in a CDMA2000 network 173
5.16 Integration with Wireless Mobile Networks 173
5.17 Conclusion 175

Chapter 6. IEEE 802.16 (WMAN/WiMax) 177

6.1 802.16 Standard 180
6.2 Design Considerations 182
6.3 Topology 184
6.4 Coverage 186
6.5 Link Budget 186
6.6 Network Considerations 188
6.7 Network Configurations 189
6.7.1 Cellular backhaul (802.16) 189
6.7.2 Wireless packet network offload (WIMAX/802.16a) 190
6.7.3 High-speed wireless packet (802.16e) 191
6.8 Integration with 2/5G/3G and 802.11 Mobility 192

Chapter 7. 802.20—MBWA 195

7.1 Migration Path 195
7.2 Technical Parameters 196
7.3 Integration 197
7.4 Differences between 802.20 and 3G 201
7.5 802.20 compared to 802.16 and 802.11 202

Chapter 8. Convergence Wireless Mobility and 802.x 205

8.1 Wi-Fi Integration 206
8.2 Commonality between WCDMA/CDMA2000 208
8.3 Software Defined Radio (SDR) 209
8.4 Ultra Wideband (UWB) 210
8.5 Business Considerations 210
8.6 Services 212
8.6.1 Home networking 213
8.6.2 802.11 and VoIP 214
8.6. 3 Hot spot (802.11/802.16) 214
8.6.4 Location based 214
8.6.5 Interactive games 214
8.6.6 Variable prepay 215
8.7 Budgeting 215
8.8 Convergence 217
8.9 Benefits of Convergence of Wi-Fi and Wireless Mobile 220

Index 225