Mobile Communication Systems

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Preface

During the past decade there has been a dramatic change in the nature of mobile communications technology and its impact on the general communications environment. In the 1970s, mobile radio was a minority activity in communications, based on relatively unsophisticated technology. The 1980s, however, have seen the emergence of analogue cellular systems and the definition of future digital systems, and the predicted demand for these services is such that investigations into the use of higher frequency bands have already begun. It is predicted that, by the late 1990s, the 'personal communications' world will have resulted in the majority of adults in Europe and North America being dependent on radio-connected terminals of various kinds for more than 50% of their total telecommunications needs. The technology which will form the basis of this revolution has now been defined, at least in outline, and the fixed and mobile equipment that will be used in systems of the future will bear little resemblance to that available even ten years ago.

It is impossible within the confines of a single, relatively short book to cover all the subject areas needed for a study of this exciting and expanding field of technology. We have, perforce, been selective and have chosen those topics which we believe to be of primary importance at the present time. Even within these topics, however, we have been further constrained to concentrate only on aspects directly relevant to mobile communications, an example of this being Chapter 4 which is concerned with modulation. We have concentrated exclusively on land mobile radio as used in the civilian scenario, and have not covered satellite mobile systems or military mobile radio. Although some topics, such as trunking, are important, we have been able to find room for only a brief treatment of the principles; readers requiring further information should consult the references at the end of the relevant chapter.

In the period up to the mid 1970s, both fixed and mobile equipment was fairly primitive and systems engineering was largely concerned with using this equipment to maximize the use of the available radio channels. In modern systems, the radio channel is still a major factor and, following Chapter 1 which gives some background for readers with little prior knowledge, we deal with the properties and characteristics of the channel with regard to both

signals and noise. We have deliberately chosen to present the information about multipath and short-term effects in Chapter 2, ahead of that on median signal strength prediction and long-term effects in Chapter 3; this seems logical to us, although there may be those who would have preferred to see the order of presentation reversed. Modulation is covered in Chapter 4, before the final chapter on the channel, which deals with noise. Again, opinions may differ on the order of presentation, but we felt that some background on modulation was needed before addressing the problem of how impulsive noise affects communication systems in Chapter 5. Diversity reception, a subject that has been researched for many years, is of increasing importance as mobile systems move into the digital era. Chapter 6 is a summary of the principles and practice which, it is hoped, will pave the way for those who wish to delve deeper into the literature.

A great deal of modern systems engineering now focuses on digital signal processing, channel and speech coding, spectrally efficient modulation methods and, perhaps most importantly, integration of the radio segment into complete systems using fixed-line networks with computer management, and with the public switch telephone network (PSTN). A detailed treatment of these topics is well beyond the scope of this book, but cellular systems embrace them all to a greater or lesser extent. In any case, cellular systems are of fundamental importance in their own right and three chapters at the end of the book are devoted to them: Chapter 7 deals with the fundamentals, Chapter 8 discusses analogue systems, using TACS as the primary example and comparing it briefly with other systems; Chapter 9 introduces the digital cellular systems of the future and shows how the techniques mentioned above influence decisions about channel bandwidth, multiple access techniques and system capacity.

Throughout the book we have, in the interests of brevity and readability, declined to reproduce lengthy mathematical derivations which can, in any case, be found elsewhere. Nevertheless, we have tried wherever possible to use the mathematical notation which is in common usage, to make it easier for readers to understand relevant published papers with a minimum of difficulty.

No book of this kind results from the efforts of only the authors whose names appear on the title page. We have been privileged, over the years, to supervise the research work of many students who have tackled difficult problems, come forward with original ideas, stimulated our thoughts and generally contributed much to our knowledge. In the context of this book, particular mention must be made of Dr Anwar Bajwa, a former student and academic colleague of J.D. Parsons, and now a valued friend; he contributed much during the early stages of writing, and his influence and advice are gratefully acknowledged. Finally, grateful thanks are due to our wives, Mary and Sheila, who have encouraged us not only in the writing of this book, but throughout our careers; they have made many sacrifices which are much appreciated.

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Contents

1	Introduction to mobile communications	1
1.1	Background	1
1.2	Mobile radio system fundamentals	2
1.2.1	The operating frequency	2
1.2.2	Modulation	5
1.3	A simple mobile radio system	5
1.4	Practical communication systems	7
1.4.1	Links	7
1.4.2	Repeaters	8
1.4.3	Talk-through	8
1.4.4	Communication with selected mobiles	9
1.4.5	Continuous tone controlled signalling system (CTCSS)	10
1.4.6	Selective calling	10
1.5	Paging	11
1.5.1	Simple paging systems	12
1.5.2	Voice paging system	12
1.5.3	Overlay paging system	13
1.5.4	Wide-area paging	13
1.6	Portables	14
1.7	Dialling systems	14
1.8	Radiophone services	15
1.9	Channel sharing	15
1.9.1	Trunking	16
1.10	Area coverage techniques	21
1.10.1	Alternative techniques	23
1.10.2	Cellular schemes	23
1.11	Present and future use of mobile radio	25
	References	26
2	Multipath characteristics in urban areas	27
2.1	Introduction	27
2.2	The nature of multipath propagation	29
2.3	Short-term fading	32
2.3.1	The scattering model	32
2.3.2	Angle of arrival and signal spectra	34
2.3.3	Fading envelope statistics	35
2.3.4	Level-crossing rate	36
2.3.5	Average fade duration	37
2.3.6	Spatial correlation of field components	37
2.3.7	Random FM	41
2.4	Frequency-selective fading	43

2.5	Channel characterization	44
2.6	Channel sounding techniques	48
2.7	Practical channel sounders	49
2.7.1	Data processing	51
2.8	Small-area characterization	53
2.8.1	Statistical characterization	55
2.9	Large-area characterization	59
2.9.1	Distribution of the channel parameters	60
2.10	Conclusions	66
	References	67
3	Propagation and signal strength prediction	68
3.1	Introduction	68
3.2	Fundamentals of VHF and UHF propagation	69
3.2.1	Propagation in free space	70
3.2.2	Propagation over a reflecting surface	71
3.2.3	The effect of surface roughness	72
3.3	Propagation over terrain obstacles	73
3.3.1	Fresnel zones	73
3.3.2	Diffraction over rounded obstacles	76
3.4	Multiple knife-edge diffraction	79
3.4.1	The Bullington equivalent knife-edge method	79
3.4.2	The Epstein–Peterson diffraction loss method	79
3.4.3	The Japanese atlas method	80
3.4.4	Picquenard's method	80
3.4.5	The Deygout method	81
3.4.6	Comparison of the diffraction models	82
3.5	Propagation prediction models	82
3.6	Signal strength prediction in urban areas	84
3.6.1	Allsebrook's method	86
3.6.2	Ibrahim's method	86
3.7	Discussion	89
3.8	Signal variability	90
3.8.1	Statistical analysis of the signal	91
3.9	Large area statistics	95
3.10	Building penetration losses	97
3.10.1	Interference effects	98
	References	99
4	Modulation techniques	101
4.1	Introduction	101
4.2	Amplitude modulation	101
4.2.1	Reduced carrier modulation	103
4.2.2	Single-sideband modulation	103
4.3	Angle modulation	103
4.3.1	Bandwidth of angle-modulated signals	104
4.3.2	Criteria for determining bandwidth	105
4.3.3	Carson's rule	105
4.3.4	Narrowband modulation	106
4.4	Implementation of AM systems	106
4.5	Single-sideband implementation	107
4.5.1	Filter method	107
4.5.2	Outphasing methods	108
4.5.3	Problems in SSB implementation	110
4.6	Demodulation	112
4.6.1	Coherent demodulation	112
4.6.2	Non-coherent (envelope) detection	114

4.7	Generation of FM signals	114
4.7.1	Direct methods	115
4.7.2	Indirect methods	115
4.8	FM demodulators	116
4.8.1	Frequency discriminators	116
4.8.2	Pulse-counting discriminators	118
4.8.3	Phase-locked loops	119
4.8.4	Quadrature detection	120
4.9	The effect of noise on AM systems	121
4.9.1	Noise performance of DSBSC and SSB	122
4.9.2	Noise performance of AM	122
4.9.3	Comparison of the modulation methods	123
4.10	The effect of noise on FM systems	124
4.10.1	The SNR-bandwidth interchange and FM threshold	124
4.10.2	Pre-emphasis and de-emphasis	126
4.11	The effects of multipath propagation	126
4.11.1	Practical SSB systems	131
4.12	Demodulation of data signals	131
4.13	Differentially encoded PSK (DPSK)	135
4.14	The effect of noise in data communication systems	135
4.15	Carrier transmissions	137
4.16	The influence of multipath fading on data transmissions	137
4.16.1	Non-coherent FSK and DPSK	139
4.16.2	Coherent systems	140
4.17	System performance	140
4.18	The fully digital approach	142
4.18.1	The principal compromises	142
4.18.2	Quadrature amplitude modulation	143
4.18.3	Frequency modulation schemes	145
	References	147

5 Man-made noise

149

5.1	Introduction	149
5.2	Characterization of pulses	150
5.3	Characterization of impulsive noise	151
5.4	Measuring equipment	154
5.4.1	Bandwidth	154
5.4.2	Dynamic range	155
5.4.3	Sensitivity and noise figure	155
5.4.4	Impulse response considerations	155
5.5	Practical measuring systems	157
5.6	Measurement of noise amplitude distribution	160
5.7	Statistical characterization of noise	161
5.8	Impulsive noise measurements	162
5.9	Summary	169
5.10	Performance prediction techniques	169
5.10.1	The assessment of receiver performance	170
5.10.2	Prediction methods using APD	177
5.10.3	Prediction methods using NAD	180
5.10.4	The Bello and Esposito technique	182
5.10.5	Application to other receivers	184
	References	186

6 Diversity reception

189

6.1	Introduction	189
6.2	Basic diversity methods	190
6.2.1	Selection diversity	192

6.2.2	Maximal-ratio combining	194
6.2.3	Equal-grain combining	195
6.3	Improvements obtainable from diversity	196
6.3.1	Envelope probability distributions	197
6.3.2	Level-crossing rate and average fade duration	201
6.3.3	Random FM	203
6.4	Switched diversity	205
6.4.1	Cumulative probability distribution	208
6.5	The effect of diversity on data systems	211
6.6	Practical diversity systems	215
6.7	Predetection diversity	216
6.7.1	Phase-sweeping or 'mode averaging' diversity	220
6.8	Diversity systems using special receivers	222
6.8.1	Pilot-tone systems	224
6.8.2	Systems without pilot-tone	225
6.9	Switched diversity	226
6.10	Comparison	230
6.11	Postdetection diversity	232
6.11.1	Use of a modified phase-correction loop	234
6.11.2	Unified analysis of postdetection diversity	235
6.11.3	Postdetection selection and switched diversity	235
6.12	Time diversity	237
6.13	Discussion and conclusions	241
	References	242
7	Using the radio channel in cellular radio networks	244
7.1	The radio channel as a system component	244
7.2	Wideband versus narrowband	245
7.3	Cellular radio fundamentals	245
7.3.1	Why 'cellular'?	245
7.3.2	Frequency re-use strategies	247
8	Analogue cellular radio systems	253
8.1	Channel structures	253
8.2	Specifications for the radio equipment	255
8.2.1	RF power levels	256
8.2.2	Modulation	256
8.2.3	Spectrum and channel designation	258
8.3	Network control activity	260
8.3.1	Dedicated control channels	260
8.3.2	Protecting data messages	260
8.3.3	Signalling formats	261
8.3.4	Supervision	265
8.4	System operation	266
8.4.1	Principal functions	266
8.4.2	Mobile scanning	269
8.4.3	Registration	269
8.4.4	Call origination	270
8.4.5	Call receipt	270
8.4.6	Hand-off	270
8.4.7	Call termination	271
8.5	Some system comparisons	271
9	Digital cellular radio systems	273
9.1	Digital versus analogue for second-generation cellular systems	273
9.2	Choice of basic system architecture	275

CONTENTS

xi

9.2.1	Single channel per carrier, FDMA	275
9.2.2	Time division multiple access	276
9.3	Essential techniques for digital implementation	277
9.3.1	Speech coding	277
9.3.2	Channel coding	280
9.3.3	Channel equalization	281
9.3.4	Frequency hopping	283
9.4	Example systems	284
9.4.1	An asymmetrical system—MATS-D	284
9.4.2	A wideband TDMA system—CD900	285
9.4.3	The GSM system—narrowband TDMA	286
9.5	Postscript	288

Index

289