

**Single- and Multi-carrier Quadrature
Amplitude Modulation:**

Principles and Applications for Personal
Communications, WLANs and Broadcasting

by

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Preface to the Second Edition

Outline

Since its discovery in the early 1960s, quadrature amplitude modulation (QAM) has continued to gain interest and practical application. Particularly in recent years many new ideas and techniques have been proposed, allowing its employment over fading mobile channels. This book attempts to provide an overview of most major QAM techniques, commencing with simple QAM schemes for the uninitiated, while endeavouring to pave the way towards complex, rapidly evolving areas, such as trellis-coded pilot-symbol and transparent-tone-in-band assisted schemes, or arrangements for wide-band mobile channels. The second half of the book is targetted at the more advanced reader, providing a research-oriented outlook using a variety of novel QAM-based single- and multi-carrier arrangements.

The book is structured in five parts. Part I - constituted by Chapters 1-4 - is a rudimentary introduction for those requiring a background in the field of modulation and radio wave propagation. Part II is comprised of Chapters 5-9 and concentrates mainly on classic QAM transmission issues relevant to Gaussian channels. Readers familiar with the fundamentals of QAM and the characteristics of propagation channels, as well as with basic pulse shaping techniques may decide to skip Chapters 1-5. Commencing with Chapter 6, each chapter describes individual aspects of QAM. Readers wishing to familiarize themselves with a particular subsystem, including clock and carrier recovery, equalisation, trellis coded modulation, standardised telephone-line modem features, etc. can turn directly to the relevant chapters, whereas those who desire a more complete treatment might like to read all the remaining chapters.

Parts III-V, including Chapters 10-24, are concerned with QAM-based transmissions over mobile radio channels. These chapters provide a research-based perspective and are dedicated to the more advanced reader. Specifically, Chapter 10 concentrates mainly on coherent QAM schemes, including reference-aided transparent-tone-in-band and pilot-symbol assisted modulation arrangements. In contrast, Chapter 11 focuses on low-complexity differentially encoded QAM schemes and on their performance with and without forward error correction coding and trellis coded modulation. Chapter 12 details various timing recovery schemes.

Part IV of the book commences with Chapter 13, which is concerned with variable rate QAM using one- to six-bits per symbol signal constellations. Chapter 14 is dedicated to high-rate wide-band transmissions and proposes a novel equaliser ar-

rangement. Various QAM-related orthogonal signaling techniques are proposed in Chapter 15, while the spectral efficiency of QAM in cellular frequency re-use structures is detailed in Chapter 16. This is followed by Chapter 17, which concentrates on the employment of QAM in a source-matched speech communications system, including various speech codecs, error correction codecs, a voice activity detector and packet reservation multiple access, providing performance figures in contrast to one and two bits per symbol bench-mark schemes.

Part V first appeared in this new edition of the book, concentrating on multi-carrier modulation. Specifically, following a rudimentary introduction to Orthogonal Frequency Division Multiplexing (OFDM) in Chapter 18, Chapters 19-23 detail a range of implementational and performance aspects of OFDM over both Gaussian and wideband fading channels. Lastly, Chapter 24 concentrates on the performance aspects of various standard-compliant and enhanced OFDM-based Digital Video Broadcasting (DVB) systems designed for transmission to mobile receivers.

To the original text of the first edition dealing with many of the fundamentals of single-carrier QAM and QAM-based systems we have added six new chapters dealing with the complexities of the exciting subject of multi-carrier modulation, which has found wide-ranging applications in a past decade, ranging from Wireless Local Area Network (WLAN) to broadcast systems. Whilst the book aims to portray a rapidly evolving area, where research results are promptly translated into products, it is our hope that you will find this second edition comprehensive, technically challenging and above all, enjoyable.

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Acknowledgement

The authors would like to express their warmest thanks to Prof. Raymond Steele. Without his shrewd long-term vision the research on single-carrier QAM would not have been performed, and without his earnest exhortations a book on the subject would not have been written. Furthermore, Professor Steele has edited some of the chapters and given advice on the contents and style of this book.

Contributions by Dr. P.M. Fortune, Dr. K.H.H. Wong, Dr. R.A. Salami, D. Greenwood, R. Stedman, R. Lucas and Dr. J.C.S. Cheung who were formerly with Southampton University thankfully acknowledged. We thank Multiple Access Communications Ltd. for supporting the work on QAM, particularly in the framework of the DTI LINK Personal Communications Programme, dealing with high data rate QAM transmission over microcellular mobile channels. Special thanks goes to Peter Gould and Philip Evans for the major part they played in the construction of the star QAM test-bed. We are grateful to John Williams of Multiple Access Communications Ltd. for the many simulation results he provided for Chapter 18, the production of many of the figures involving simulated waveforms, and not least, for the cover design. Much of the QAM work at Multiple Access Communications Ltd. derives from the support of BT Labs. Martlesham Heath, the DTI and the Radio Communications Agency. Specifically, we thank the latter for the support of the research on spectral efficiency which facilitated Chapter 17.

Much of the results in Chapters 19-22 are based on our work conducted as a sub-contractor of Motorola ECID, Swindon, UK; as part of our involvement in a collaborative Pan-European Wireless Asynchronous Transfer Mode (WATM) project known as Median, which was generously supported by the European Commission (EC), Brussels, Belgium. We would like to acknowledge all our valued friends and colleagues - too numerous to mention individually - who at some stage were associated with the Median consortium and with whom we have enjoyed a stimulating collaboration under the stirring management of IMST, Germany. Our gratitude is due to Andy Wilton and to Paul Crichton of Motorola, who have whole-heartedly sponsored our research. Further thanks are also due to Dr. Joao Da Silva, Bartolome Aroyo, Bernard Barani, Dr. Jorge Pereira, Demosthenes Ikonou and to the other equally supportive members of the EC's programme management team in Brussels for their enthusiastic support. Furthermore, we enjoyed the valuable support of EPSRC, Swindon UK, and the Mobile VCE, for which we are equally grateful.

Lastly, we express our gratitude for the creative atmosphere to our colleagues Derek Appleby, Steve Braithwaite, Sheng Chen, David Stewart as well as Stephan Weiss at Southampton University, UK and gratefully acknowledge the stimulating embryonic discussions with Prof. G. Gordos (Technical University of Budapest, Hungary), Prof. H.W. Schüssler (University of Erlangen-Nürnberg, Germany) and Dr. Ing. H.J. Kolb as well as the numerous thought-provoking contributions by many established authorities in the field, who appear also in the Author Index Section of the book.

A number of colleagues have influenced our views concerning various aspects of wireless communications and we thank them for the enlightenment gained from our collaborations on various projects, papers and books. We are grateful to J. Brecht,

Jon Blogh, Marco Breiling, M. del Buono, Clare Brooks, Peter Cherriman, Stanley Chia, Byoung Jo Choi, Joseph Cheung, Peter Fortune, Lim Dongmin, D. Didascalou, S. Ernst, Eddie Green, David Greenwood, Hee Thong How, Thomas Keller, W.H. Lam, C.C. Lee, M.A. Nofal, Xiao Lin, Chee Siong Lee, Tong-Hooi Liew, Matthias Muenster, V. Roger-Marchart, Redwan Salami, David Stewart, Juergen Streit, Jeff Torrance, Spyros Vlahoyiannatos, William Webb, John Williams, Jason Woodard, Choong Hin Wong, Henry Wong, James Wong, Lie-Liang Yang, Bee-Leong Yeap, Mong-Suan Yee, Kai Yen, Andy Yuen and many others with whom we enjoyed an association. Special thanks are due to Dr. Lie-Liang Yang for his insightful contributions on the theory of the coding schemes used in Chapter 23, to Tong-Hooi Liew for his kind assistance in the preparation of Chapter 23, which resulted in a joint journal submission. Furthermore, the contributions of Chee-Siong Lee and Spyros Vlahoyianatos to Chapter 24 are also gratefully acknowledged. We are also grateful to our editors, Mark Hammond and Juliet Booker at Wiley. Finally, the authors warmly thank Rita Hanzo, Denise Harvey and Dr. Peter Cherriman for their dedicated and skilful assistance in typesetting the manuscript in Latex, scanning the missing figures and amalgamating the new material of the second edition with the first edition.

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Single- and Multi-Carrier Quadrature Amplitude Modulation:

by L. Hanzo, W.T. Webb and T. Keller

This book attempts to provide an overview of most major QAM techniques, commencing with simple QAM schemes for the uninitiated, while endeavouring to pave the way towards complex, rapidly evolving areas, such as trellis-coded pilot symbol and transparent tone in band assisted orthogonal multiplex schemes, or arrangements for wide-band mobile channels. The second half of the book is targeted at the more advanced reader, providing a research-oriented outlook using a variety of novel QAM-based arrangements.

The book is structured in five parts. Part I is a rudimentary introduction for readers requiring a background in the field of modulation and communications channels. Part II concentrates mainly on classic QAM transmission issues relevant to Gaussian channels, including clock and carrier recovery, equalisation, trellis coded modulation, standardised CCITT V-series modem features, etc. Parts III-V are concerned with QAM for mobile radio channels, including more complex coherent reference-aided transparent-tone-in-band, pilot symbol assisted and trellis coded modulation schemes. These are contrasted with various differentially coded low-complexity non-coherent arrangements. Then the reader is guided through an adaptive modem optimising its phasor constellation for various conditions, before high-rate wide-band transmissions and a novel channel equaliser are considered. Part IV incorporates QAM-related orthogonal techniques and considers the spectral efficiency of QAM in cellular frequency re-use structures, before concluding with a QAM-based speech communications system design study, including various speech codecs, error correction codecs, a voice activity detector and packet reservation multiple access, providing performance figures in contrast to one and two bits per symbol bench-mark schemes. Lastly, Part V provides an in-depth study of Orthogonal Frequency Division Multiplex systems, which are applicable to Wireless Local Area Networks (WLAN) and Digital Video Broadcasting (DVB).

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