

# Preface

The demand for multimedia wireless communications is growing today at an explosive pace. One common feature of many current wireless standards for high-rate multimedia transmission is the adoption of a multicarrier air interface based on either orthogonal frequency-division multiplexing (OFDM) or orthogonal frequency-division multiple-access (OFDMA). The latest examples of this trend are represented by the IEEE 802.11 and IEEE 802.16 families of standards for wireless local area networks (WLANs) and wireless metropolitan area networks (WMANs). Although the basic principle of OFDM/OFDMA is well established among researchers and communication engineers, its practical implementation is far from being trivial as it requires rather sophisticated signal processing techniques in order to fully achieve the attainable system performance.

This book is intended to provide an accessible introduction to OFDM-based systems from a signal processing perspective. The first part provides a concise treatment of some fundamental concepts related to wireless communications and multicarrier systems, whereas the second part offers a comprehensive survey of recent developments on a variety of critical design issues including synchronization techniques, channel estimation methods, adaptive resource allocation and practical schemes for reducing the peak-to-average power ratio of the transmitted waveform. The selection and treatment of topics makes this book quite different from other texts in digital communication engineering. In most books devoted to multicarrier transmissions the issue of resource assignment is not discussed at all while synchronization and channel estimation are only superficially addressed. This may give the reader the erroneous impression that these tasks are rather trivial and the system can always operate close to the limiting case of ideal synchronization and channel estimation. However, as discussed

in this book, special design attentions are required for successfully accomplishing these tasks. In many cases, the trade-off between performance and system complexity has to be carefully taken into consideration in the practical implementation of multicarrier systems.

Most of the presented material originates from several projects and research activities conducted by the authors in the field of multicarrier transmissions. In order to keep the book concise, we do not cover advanced topics in multiple-input multiple-output (MIMO) OFDM systems as well as latest results in the field of resource assignment based on game theory. Also, we do not include a description of current wireless standards employing OFDM or OFDMA which are available in many other texts and journal papers.

The book is written for graduate students, design engineers in telecommunications industry as well as researchers in academia. Readers are assumed to be familiar with the basic concepts of digital communication theory and to have a working knowledge of Fourier transforms, stochastic processes and estimation theory. Whenever possible, we have attempted to keep the presentation as simple as possible without sacrificing accuracy. We hope that the book will contribute to a better understanding of most critical issues encountered in the design of a multicarrier communication system and may motivate further investigation in this exciting research area.

The authors acknowledge contributions of several people to the writing of this book. Many thanks go to Prof. Umberto Mengali who reviewed several portions of the manuscript and suggested valuable improvements to its original version. Without his advice and encouragement, this book would never have seen the light of day. We would also like to express appreciation to our co-workers and friends Antonio D'Amico, Marco Moretti and Luca Sanguinetti who reviewed the manuscript in detail and offered corrections and insightful comments. To all of them we owe a debt of gratitude. Special thanks go to Ivan Cosovic from NTT-DoCoMo, who critically read a first draft of the manuscript and provided invaluable suggestions.

M. Pun would like to thank his former colleagues at the SONY corporation, particularly Takahiro Okada, Yasunari Ikeda, Naohiko Iwakiri and Tamotsu Ikeda for first teaching him about the principle of OFDM. M. Pun would also like to acknowledge the Sir Edward Youde Foundation and the Croucher Foundation for supporting him in his research activity. M. Morelli would like to thank his wife Monica and son Tommaso for their support and understanding during the time he devoted to writing this book, and to his parents for their endless sacrifices. C.-C. J. Kuo would like to thank his

parents, his wife Terri and daughter Allison for their encouragement and support for years.

*Man-On Pun*  
*Michele Morelli*  
*C.-C. Jay Kuo*