CDMA: Principles of Spread Spectrum Communication

Andrew J. Viterbi
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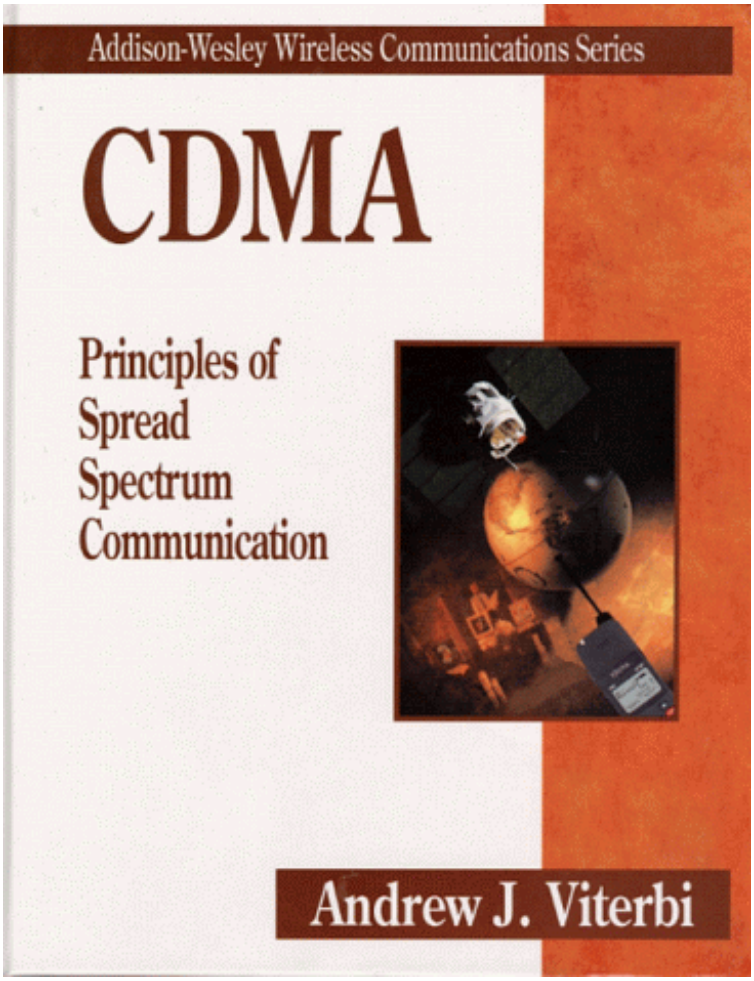

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Andrew J. Viterbi : CDMA: Principles of Spread Spectrum Communication before purchasing it in order to gage whether or not it would be worth my time, and all praised CDMA: Principles of Spread Spectrum Communication:

0 of 1 people found the following review helpful. There are better books than this.By BENEDITO DAMACENO GOESI found this book very difficult to understand since I am a newcomer to this subject. I'm sure you can find easier books to understand if you are a beginner20 of 22 people found the following review helpful. Excellent reading. Well structured and detail oriented.By A CustomerThis book does a wonderful job in gradually building on the important aspects of spread spectrum technology. I liked the structure of the book more than anything else. It gradually explains important principles of CDMA technology, chapter by chapter. This book stands out from others in that the author had taken a very systematic approach in explaining each topic. This book covers all aspects of spread spectrum technology, and is good for people who are new to this field, too. I'd just suggest that readers do not get intimidated by the numerous mathematical equations present in this book. These equations merely help to explain the mathematical

side of timing, sequence generation, modulation and demodulation, cell interferences, etc. Definitely not a bed-time reading book, but for a more serious reader who wants to learn about CDMA. One last word about the author...Andy Viterbi is a pioneer of this technology and commensurate with his reputation, he has done an excellent work on this text.16 of 16 people found the following review helpful. principles of spread spectrum communicationBy A CustomerPerhaps not the best book for a beginner in CDMA, but is a very good book if you have some background in CDMA and are interested in finding out the reasons why certain things are done in the IS-95 or other CDMA standards, and the analysis/performance of the CDMA system. I liked the book because it is to the point which is nice (of course, assuming you have prior knowledge about digital communications and are familiar with CDMA). But the material covered in the book may be a little daunting to a beginner in CDMA.

Spread spectrum technology, used in military applications for a number of years, now provides an innovative solution to the problem of congestion in the cellular network. CDMA is designed to introduce electrical and comunications engineers to this important area of wireless digital communications.

From the Inside FlapSpread spectrum communication technology has been used in military communications for over half a century, primarily for two purposes: to overcome the effects of strong intentional interference (jamming), and to hide the signal from the eavesdropper (covertness). Both goals can be achieved by spreading the signal's spectrum to make it virtually indistinguishable from background noise. Several texts, or portions of texts, on this subject have been published over the past twenty years. This book is the first to present spectrum technology specifically for commercial wireless applications. In response to an ever-accelerating worldwide demand for mobile and personal portable communications, spread spectrum digital technology has achieved much higher bandwidth efficiency for a given wireless spectrum allocation, and hence serves a far larger population of multiple access users, than analog or other digital technologies. While it is similar in implementation to its military predecessors, the spread spectrum wireless network achieves efficiency improvements by incorporating a number of unique features made possible by the benign noise-like characteristics of the signal waveform. Chief among these is universal frequency reuse (the fact that all users, whether communicating within a neighborhood, a metropolitan area, or even a nation, occupy a common frequency spectrum allocation). Besides increasing the efficiency of spectrum usage, this also eliminates the chore of planning for different frequency allocation for neighboring users or cells. Many other important multiple access system features are made possible through this universal frequency reuse by terminals employing wideband (spread) noise-like signal waveforms. Most important is fast and accurate power control, which ensures a high level of transmission quality while level for each terminal, and hence a low level of interference to other user terminals. Another is mitigation of faded transmission through the use of a Rake receiver, which constructively combines multipath components rather than allowing them to destructively combine as in narrowband transmission. A third major benefit is soft handoff among multiple cell base stations, which provides improved cell-boundary performance and prevents dropped calls. In Chapters 2 to 5, this book covers all aspects of spread spectrum transmission over a physical multiple-access channel: signal generation, synchronization, modulation, and error-correcting coding of direct-sequence spread spectrum signals. Chapter 6 relates these physical layer functions to link and network layer properties involving cellular coverage, Erlang capacity, and network control. This outline is unusual in bringing together several wide-ranging technical disciplines, rarely covered in this sequence and in one text. However, the presentation is well integrated by a number of unifying threads. First, the entire text is devoted to the concept of universal frequency reuse by multiple users of multiple cells. Also, two fundamental techniques are used in a variety of different forms throughout the text. The first is the finite-state machine representation of both deterministic and random sequences; the second is the use of simple, elegant upper bounds on the probabilities of a wide range of events related to system performance. However, given the focus on simultaneous wideband transmission for all users over a common frequency spectrum, the text purposely omits two important application areas: narrowband modulation and coding methods, including multipoint signal constellations and trellis codes; and frequency hopped multiple access, where modulation waveforms are instantaneously narrowband over the duration of each hop. It also generally avoids digressions into principles of information theory. In short, although the material covered through Chapter 5 mostly also applies to narrowband digital transmission systems, the book mainly covers topics that apply to wideband spread spectrum multiple access. Three motivating forces drove me to write this book. It began with my three decades of teaching within the University of California system. There, keeping with the healthy trend in communication engineering courses, I tried to make theory continually more pertinent to applications. Then there was the fulfillment of a voluntary commission for the Marconi Foundation, which honored me with a Marconi Fellowship award in 1990. Most important was my participation in a significant technological achievement in communication system evolution: the implementation, demonstration, and standardization of a digital cellular spread spectrum code-division multiple access (CDMA) system. Adopted in 1993 by the Telecommunication Industry Association, the CDMA standard IS-95 is the embodiment of many of the principles presented in this text. Although this book is not meant solely for this purpose, it does explain and justify many of the techniques contained in the standard. I emphasize, however, that my

goal is to present the principles underlying spread spectrum communication, most but not all of which apply to this standard. It is not to describe in detail how the principles were applied. This is left to the practicing engineer with the patience and commitment to delve into the details and correlate them with the principles presented here. Which brings me to the question of prerequisites for a basic understanding. Several excellent texts on statistical communication and information theory have been available for almost four decades. Thus, I have not tried to provide all the fundamentals. The text is nevertheless self-contained: any significant results are derived either in the text or in appendices to the chapter where they are first used. Still, the reader should have at least an undergraduate electrical engineering background with some probability and communication engineering content. A first-year engineering graduate course in communication theory, stochastic processes, or detection and estimation theory would be preferable. As a text for a graduate-level course, the book can be covered in one semester, and with some compromises even in one quarter. It is equally suitable for a one- or two-week intensive short course. This leaves only the pleasant task of thanking the many contributors to the creation of this text. First, from my superb group of colleagues at QUALCOMM Incorporated, running the gamut from mature and renowned engineers to newly minted graduates, have come the inventive system concepts and the innovative implementation approaches that turned the complex concepts into a useful reality. Among the major contributors, Klein Gilhousen, Irwin Jacobs, Roberto Padovani, Lindsay Weaver, and Charles Wheatley stand out. On the more focused aspects of the text, and the research which preceded it, I owe an enormous debt to Audrey Viterbi. She contributed not only ideas, but also considerable dedication to turn fluid concepts and derivations into firmer results with solid theoretical or simulation support. Finally, she was the first to read, critique, and error-correct the entire manuscript. Over a number of years, Ephraim Zehavi's many ideas and novel approaches have produced results included here. Jack Wolf, always a clear expositor, suggested several improvements. When it came to reviewing the final text and offering corrections and changes, I am indebted to more people than I can recall. Foremost among them are my collaborators at QUALCOMM, including Joseph Odenwalder, Yu-Cheun Jou, Paul Bender, Walid Hamdy, Samir Soliman, Matthew Grob, John Miller, and John McDonough. The last three served as experimental subjects among the first set of graduate students on which I class-tested the entire text. Very helpful outside reviews have come from Robert Gallager, Bijan Jabbari, Allen Levesque, James Mazo, Raymond Pickholtz, and Robert Scholtz. To all of the above, and especially to Deborah Casher, my infinitely patient and cooperative assistant, who processed all of my words and equations, I express my sincere thanks. 0201633744P04062001From the Back CoverSpread spectrum multiple access communication, known commercially as CDMA (Code Division Multiple Access), is a driving technology behind the rapidly advancing personal communications industry. Its greater bandwidth efficiency and multiple access capabilities make it the leading technology for relieving spectrum congestion caused by the explosion in popularity of cellular mobile and fixed wireless telephones and wireless data terminals. CDMA has been adopted by the Telecommunications Industry Association (TIA) as a wireless standard. As an electrical or communications engineer, you must acquire a thorough grasp of CDMA fundamentals in order to develop systems, products, and services for this demanding but rewarding market. Written by a leader in the creation of CDMA and an internationally recognized authority on wireless digital communication, this book gives you the technical information you need. It presents the fundamentals of digital communications and covers all aspects of commercial direct-sequence spread spectrum technology, incorporating both physical-level principles and network concepts. You will find detailed information on signal generation, synchronization, modulation, and coding of direct-sequence spread spectrum signals. In addition, the book shows how these physical layer functions relate to link and network properties involving cellular coverage, Erlang capacity, and network control. With this book, you will attain a deeper understanding of personal communications system concepts and will be better equipped to develop systems and products at the forefront of the personal wireless communications market. 0201633744B04062001About the AuthorAndrew J. Viterbi is a pioneer of wireless digital communications technology. He is best known as the creator of the digital decoding technique used in direct-broadcast satellite television receivers and in wireless cellular telephones, as well as numerous other applications. He is co-founder, Chief Technical Officer, and Vice Chairman of QUALCOMM Incorporated, developer of mobile satellite and wireless land communication systems employing CDMA technology. Dr. Viterbi has received numerous awards, including the Christopher Columbus Medal, the IEEE Alexander Graham Bell Award, the Marconi International Fellowship Award, the IEEE Information Society Shannon Lecturer Award, and awards from the NEC CC Foundation and the Eduard Rhein Foundation. 0201633744AB04062001