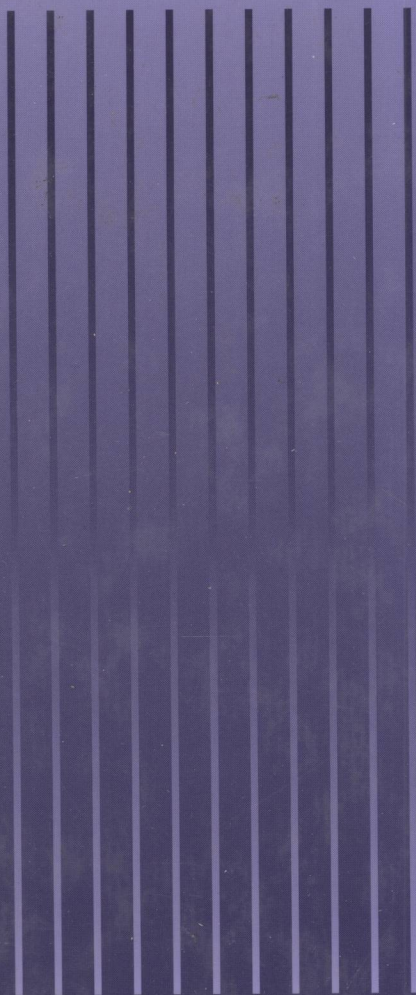


BUILDING BROADBAND NETWORKS



Marlyn Kemper Littman



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BUILDING BROADBAND NETWORKS



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Dedication

*For my husband Rabbi Lewis Littman, D.D.,
for making every day special*

Preface

Accelerating demand for extendible, dependable, and scalable high-speed, high-performance networks with vast transmission capacities and potentially unlimited bandwidth contributes to the present-day popularity of broadband communications technologies. *Building Broadband Networks* is a comprehensive examination of recent developments and innovations in this dynamic field of study.

The text provides a foundation for understanding distinctive attributes and functions of broadband technologies and the support of these technologies in enabling development of high-performance, high-capacity, and high-speed networking configurations. Technical features and functions, standards activities, and approaches for enabling effective broadband network deployment are described. Practical considerations for building broadband networks that are extendible, flexible, available, scalable, and reliable are presented. Representative broadband tele-education initiatives that enable students and lifelong learners to participate in virtual classes, telecourses, and teleprograms, regardless of geographic location, are highlighted. National and international research and education networks that provision a diverse and powerful mix of broadband services are highlighted. Wireless solutions that support fast Web connectivity at any time and from any place are indicated. Advanced broadband network applications such as digital libraries and information grids are described. Capabilities of undersea networks and powerline configurations are explored.

Building Broadband Networks is written from a contemporary perspective. Emphasis is placed on exploring the distinctive characteristics of broadband technologies, architectures, and services and current and next-generation networking implementations in present-day environments.

This book begins with an examination of ISDN (Integrated Services Digital Network) and ATM (Asynchronous Transfer Mode) technologies. Optical network solutions based on SONET/SDH (Synchronous Optical Network and Synchronous Digital Hierarchy), WDM (Wavelength Division Multiplexing), and DWDM (Dense WDM) technologies are then described.

The text continues with an exploration of Ethernet, Fast Ethernet, Gigabit Ethernet, and 10 Gigabit Ethernet operations and services. Features and functions of Frame Relay and Fibre Channel networks are introduced. Distinctive attributes of DSL (Digital Subscriber Line) solutions and wireline and wireless cable networks in the residential broadband access arena are then delineated.

Capabilities of second- and third-generation cellular communications technologies, such as GSM (Global System for Mobile Communications) and UMTS (Universal Mobile Telecommunications Systems) in provisioning access to communications resources at any time and from any place, are reviewed. Distinguishing characteristics of wireless networking technologies and configurations such as Bluetooth and IEEE 802.11b Ethernet WLANs (Wireless Local Area Networks) in

enabling multimedia applications in research and actual environments are described. An examination of satellite technologies and a description of broadband satellite network implementations are presented. Next-generation high-speed, high-performance network configurations such as Internet2 (I2) and GÉANT, the next-generation pan-European network, are explored as well. The text concludes with an exploration of network security problems and solutions.

Demand for fast, reliable, and secure access to bandwidth-intensive Web resources contributes to the development and implementation of a remarkable array of broadband networks and media-rich network applications and services. Although Internet addresses are subject to change, the Web remains a good source for monitoring developments in network technologies that are examined in this book. As a consequence, pointers to selected Web sites are provisioned at the conclusion of each chapter. An online component to this text at <http://www.scis.nova.edu/~marlyn> provides links to relevant Web sites, as they become available. Broadband networks capable of transmitting voice, video, data, and still-image traffic across localities, cities, regions, and continents are being implemented at an unprecedented rate. There is an expanding range of innovative options in the broadband network arena. A flood of specialized acronyms accompanies the rapid emergence of these technologies and configurations.

The process of building and deploying broadband communications networks is technically complicated. There is no single solution. Decisions are dependent upon multiple factors such as the mission, goals, and objectives of the sponsoring entity; capabilities of the in-place infrastructure; and application, security, and performance requirements.

Building Broadband Networks is about the mortar and bricks out of which broadband networks are built. My goal in writing this book is to provide a practical yet detailed explanation of major technologies, standards, applications, and solutions in the broadband network arena. The subject itself is complex. Sufficient technical detail and technical clarity are provided to remove the confusion and mystery surrounding the topic. Important broadband initiatives are described to provide readers with an understanding of practical implementations that distinguish this rapidly expanding field.

There are numerous networking configurations in use, each with distinctive performance characteristics, advantages, and limitations. Complex technological advancements, the remarkable increase in network capacity, the multiplicity of networking applications, and pressures to improve the quality and reliability of network services underscore the importance of developing and implementing effective broadband networking solutions.

Basic communications technologies, architectures, and protocols are examined in introductory undergraduate and graduate textbooks in the field of telecommunications and computer networks. However, there remains a need for a text in the academic arena that examines the distinctive attributes of high-performance broadband communications technologies and focuses specifically on current and next-generation wireless and/or wireline network implementations in real-world and research environments. This book accomplishes these objectives.

Building Broadband Networks is designed for senior undergraduate students and graduate students in the fields of education, information systems, and information science. It can also be used by faculty, corporate, and academic administrators and managers, network planners and consultants, information systems specialists, and librarians who want to learn more about the capabilities of broadband communications technologies and current and next-generation networking initiatives. This book can be readily employed as a textbook for advanced undergraduate and graduate courses in telecommunications and computer networks.

Material in this book has been examined in doctoral courses in telecommunications and computer networks taught by this author at the Graduate School of Computer and Information Sciences at Nova Southeastern University over the past 15 years.

Communications services, products, equipment, and solutions available from vendors, NSPs (Network Service Providers), and communications carriers mentioned in this text illustrate the features, functions, and capabilities of the technologies that are described. This information should not be interpreted as any kind of endorsement.

The Author

Marlyn Kemper Littman, Ph.D., is a Professor at the Graduate School of Computer and Information Sciences at Nova Southeastern University. Dr. Littman teaches doctoral courses and mentors doctoral candidates in the field of telecommunications and computer networks. Dr. Littman is the author of numerous professional publications in the telecommunications and computer network arena, beginning with the publication of her book entitled *Networking: Choosing a LAN Path to Interconnection* in 1987.

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This book is dedicated with all my love to my husband Lew for his extraordinary encouragement and remarkable patience during the seemingly endless days I spent on the Web immersed in broadband technologies, services, applications, and initiatives.

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