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ISSA

Fundamentals of Communications and Networking

THIRD EDITION

Michael G. Solomon | David Kim



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World Headquarters

Jones & Bartlett Learning
5 Wall Street
Burlington, MA 01803
978-443-5000
info@jblearning.com
www.jblearning.com

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And both our sons have always been sources of support and inspiration. To Noah, who still challenges me, keeps me sharp, and tries to keep me relevant; and Isaac, who left us far too early. We miss you, son.

—Michael G. Solomon

I dedicate this book to my twin-flame soulmate MiYoung Kim. No matter where our life journey takes us, I will always be waiting for you at the heaven train station (since you have my ticket)!

—David Kim

Preface

Purpose of This Book

This book is part of the Information Systems Security & Assurance Series from Jones & Bartlett Learning (www.jblearning.com). Designed for courses and curricula in IT Security, Cybersecurity, Information Assurance, and Information Systems Security, this series features a comprehensive, consistent treatment of the most current thinking and trends in this critical subject area. These titles deliver fundamental information security principles packed with real-world applications and examples. Authored by Certified Information Systems Security Professionals (CISSPs), they deliver comprehensive information on all aspects of information security. Reviewed word for word by leading technical experts in the field, these books are not only current but also forward-thinking—putting you in the position to solve the cybersecurity challenges not just of today but of tomorrow as well.

This book is a resource for understanding today's networks and the way they support the evolving requirements of different types of organizations. Networks have long been regarded as methods to connect resources. While this is still the case, today's networks are required to support an increasing array of real-time communication methods. Video chat, real-time messaging, and always-connected resources put demands on networks that were previously unimagined. Networks must respond to user requests in ways that require sub-second round-trip times. Such demands mean that network designers must rethink how they set up topologies or network layouts. Reliance on higher-layer flexibility is not sufficient. Performance often rises above flexibility in design priority.

Part 1 of the text covers the critical issues of designing a network that will meet an organization's performance needs. You will learn about how businesses use networks to solve business problems—not just technical problems. Today's networks must not only be technically proficient but they must also perform to a degree that they support an organization's ability to conduct operations as effectively as possible.

In Part 2, you will read about network basics and how to build functionality to support business demands. The focus of the topics is both on the technology and how the technology meets business goals. A functional network allows an organization to meet its goals—regardless of the technology it employs. You will learn how to choose what works for your organization. This text is organized to describe the basics of how networks work, how they support increasing demands of advanced communications, and how to map the right technology to the organization's needs.

Building a network is a great challenge. Once everything is up and running, keeping that network running smoothly is a new challenge. In Part 3 of this book, you will read about managing networks, keeping them secure, and responding when incidents occur.

Learning Features

The writing style of this book is practical and conversational. Step-by-step examples of information security concepts and procedures are presented throughout the text. Each chapter begins with a statement of learning objectives. Illustrations are used both to clarify the material and to vary the presentation. The text is sprinkled with Notes, Tips, FYIs, Warnings, and sidebars to alert the reader to additional helpful information related to the subject under discussion. Chapter Assessments appear at the end of each chapter, with solutions provided in the back of the book. Chapter summaries are included in the text to provide a rapid review or preview of the material and to help students understand the relative importance of the concepts presented.

Audience

The material is suitable for undergraduate or graduate computer science majors or information science majors, students at a two-year technical college or community college who have a basic technical background, or readers who have a basic understanding of IT security and want to expand their knowledge.

New to This Edition

This new edition has been updated to reflect the networking environments you will encounter in today's organizations. The content is organized logically to lead readers to a solid understanding of how networks work. Part 1, *Evolution of Communications*, covers how networks developed followed by Part 2, *Fundamentals of Wired and Wireless Networks*, which is a comprehensive dive into networking protocols and their uses. And finally, Part 3, *Network Management and Security*, introduces the concepts and tools needed to keep today's networks operating effectively and securely. This edition has been reorganized to align more closely with the OSI model to provide readers with a layered approach to understanding how networks really work. The latest techniques and protocols have been added to the material to provide coverage for readers who are new to networking concepts as well as those preparing for industry standard networking certifications. Concrete examples have been added to help present concepts that readers will encounter.

Readers will learn about networks from the physical layer up to the application layer and how each layer impacts the network's usability and its security. This edition also focuses on the topics of implementing and managing complex networks. Topics such as auditing, monitoring, interruption planning, troubleshooting, and incident response have been added or expanded to provide readers with a better understanding of general network operations requirements. Throughout the book, this edition is built on previous content to better punctuate the most important topics and added content to align with today's

business requirements for its networks. This edition is loaded with real-world examples, technical tips, and notes throughout to help prepare readers to solve technical challenges that network engineers commonly face.

Cloud Labs

This text is accompanied by Cybersecurity Cloud Labs. These hands-on virtual labs provide immersive mock IT infrastructures where students can learn and practice foundational cybersecurity skills as an extension of the lessons in this textbook. For more information or to purchase the labs, visit go.jblearning.com/netcomm3e.

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Michael G. Solomon

First, I would like to thank Michael Solomon for convincing me to participate in this 3rd edition update to “Fundamentals of Communications & Networking”. Co-authoring a book requires a certain amount of patience and understanding for what the other author is writing. Working with Michael has not only brought our professional lives together but also our personal lives. I consider Michael my friend now thanks to multiple book projects we have co-authored together over the past few years.

Second, I am grateful for the professional support team put together by Jones & Bartlett Learning and the Ascend Learning team. Working with Ned, Belinda, Kim, Paula, Melissa, and our technical editing duo of Jeff and Chris made this fun and engaging from start to finish. Thank you so much for your fluid workflows and constant push to get things done on time. I am convinced now that authoring a book can be fun and engaging.

Third, to the reader or student of this book, congratulations! You are on the right career path. Any information technology (IT) career path that you take must include a foundational understanding of how data networking works. Understanding TCP/IP protocol behavior and how data networking works will help any IT professional with their career given that IP communications is fundamental to how today's applications and the Internet operate.

Finally, behind every book, chapter, page, word, and line drawing that I have ever created is a woman who has always stood by my side, day and night, for better or worse, in health or in sickness, and until death do us part. When I am in book-writing mode, she brings me my morning coffee, feeds me from dawn to dusk, sings love songs for me when I have a lull, and ensures that I have quiet time when I am writing a book chapter. She is and always will be the one who gives me purpose in life to work hard, to be the best I can be, and to make me always want to love her and our children more.

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LeTourneau University

Richard W. Vanderbilt
University Heights

John M. Hunt
Covenant College

About the Authors

Michael G. Solomon, PhD, CISSP, PMP, CISM, PenTest+, CySA+, is an author, educator, and consultant focusing on privacy, security, blockchain, and identity management. As an IT professional and consultant since 1987, Dr. Solomon has led project teams for many Fortune 500 companies and has authored and contributed to more than 25 books and numerous training courses. Dr. Solomon is a Professor of Cybersecurity and Global Business with Blockchain Technology at the University of the Cumberland and holds a PhD in Computer Science and Informatics from Emory University.

David Kim, BSEE, CCNA, CISSP, CSCI, is president of Security Evolutions, Inc. (SEI), located outside of the metropolitan Washington, D.C., area. SEI provides governance, risk, compliance, and IT security consulting services for public- and private-sector clients worldwide. Mr. Kim's IT and IT security experience encompasses more than 30 years of technical engineering, technical management, and solutions selling and sales management. This experience includes LAN/WAN, internetworking, enterprise network management, and IT security for voice, video, and data networking infrastructures. He is an accomplished author and part-time adjunct professor who enjoys teaching cybersecurity to students across the United States.

