

Contents

| | | | |
|--|-------|---|-----|
| Contributors | xvii | Video Compression | 227 |
| Preface | xxiii | <i>Immanuel Freedman</i> | |
| Guide to The Handbook of Computer Networks | xxvi | Speech and Audio Compression | 268 |
| Reviewers List | 1055 | <i>Peter Kroon</i> | |
| Index | 1065 | Multimedia Streaming | 282 |
| | | <i>Nabil J. Sarhan</i> | |
| | | High-Definition Television | 293 |
| | | <i>Jim Krause</i> | |
| Volume I: Key Concepts, Data Transmission, and Digital and Optical Networks | | | |
| Part 1: Key Concepts | | Part 2: Hardware, Media, and Data Transmission | |
| The Telecommunications Industry | 3 | Modems | 309 |
| <i>David G. Loomis</i> | | <i>Darren B. Nicholson and Jennifer A. Nicholson</i> | |
| Data Communications Basics | 19 | Conducted Communications Media | 320 |
| <i>Hossein Bidgoli</i> | | <i>Thomas L. Pigg</i> | |
| Data-Link Layer Protocols | 30 | Wireless Channels | 334 |
| <i>Stefan Joe-Yen and Chadwick Sessions</i> | | <i>Okechukwu C. Ugweje</i> | |
| Network Layer Protocols | 40 | Sources of Errors, Prevention, Detection, and Correction | 352 |
| <i>Muhannad Harrim, Mohamed El-Wakil, and Ala Al-Fuqaha</i> | | <i>Syed H. Murshid and Azhar M. Khayrattee</i> | |
| Transport Layer Protocols | 63 | Routers | 364 |
| <i>Vassilis Tsaoussidis</i> | | <i>Min Song</i> | |
| Session, Presentation, and Application Layer Protocols | 76 | Switches | 375 |
| <i>Chadwick Sessions</i> | | <i>Min Song</i> | |
| Digital Transmission | 84 | Bridges | 390 |
| <i>Marvi Teixeira and Viktor Zaharov</i> | | <i>Zartash Afzal Uzmi and Tariq Mahmood Jadoon</i> | |
| Analog Transmission | 102 | Pulse Amplitude Modulation | 403 |
| <i>Hamidreza Saligheh, Joonhyuk Kang, Jaehak Chung, and Vahid Tarokh</i> | | <i>Muneo Fukaishi</i> | |
| Voice Communications Systems: KTS, PBX, Centrex, and ACD | 115 | Frequency and Phase Modulation | 414 |
| <i>Hassan Ibrahim</i> | | <i>Albert Lozano-Nieto</i> | |
| Messaging Systems: Facsimile and Voice Processing | 127 | Carrierless Amplitude Phase Modulation | 426 |
| <i>Albert K.S. Wong, Nan Zhang, and Xu Yan</i> | | <i>Tim Collins</i> | |
| Public Switched Telephone Network | 158 | Minimum Shift Keying | 438 |
| <i>Jingxuan Liu and Nirwan Ansari</i> | | <i>Tao Jiang</i> | |
| Information Theory | 178 | Optical Differential Phase Shift Keying | 455 |
| <i>David Blockus and Mark Stamp</i> | | <i>Xiang Liu</i> | |
| Data Compression | 199 | DMT Modulation | 473 |
| <i>Chang-Su Kim and C.C. Jay Kuo</i> | | <i>Stephan Pfletschinger</i> | |
| Image Compression | 212 | Pulse Position Modulation | 492 |
| <i>Alfred Mertins</i> | | <i>Jon Hamkins</i> | |

| | | | |
|--|------------|---|------------|
| Digital Phase Modulation and Demodulation | 509 | Fiber-Optic Filters and Multiplexers | 850 |
| <i>Zartash Afzal Uzmi</i> | | <i>Hamid Hemmati</i> | |
| Line Coding | 522 | Optical Solitons | 861 |
| <i>Asim Loan</i> | | <i>Natalia M. Litchinitser</i> | |
| Spread Spectrum | 538 | Synchronous Optical Code Division Multiplexing Systems | 885 |
| <i>Murad Hizlan</i> | | <i>Hideyuki Sotobayashi</i> | |
| Frequency Division Multiplexing | 553 | Free-Space Optics | 900 |
| <i>Zhu Liu</i> | | <i>John Liu and Mark Schaefer</i> | |
| Time Division Multiplexing | 568 | Optical Switching Techniques in WDM Optical Networks | 909 |
| <i>William A. Shay</i> | | <i>Amor Lazzez, Noureddine Boudriga, and Mohammad S. Obaidat</i> | |
| Statistical Time Division Multiplexing | 579 | SONET and SDH Networks | 929 |
| <i>Kavitha Chandra</i> | | <i>M. Farooque Mesiya</i> | |
| Orthogonal Frequency Division Multiplexing | 591 | Passive Optical Networks for Broadband Access | 948 |
| <i>Shinsuke Hara</i> | | <i>Nirwan Ansari and Yuanqiu Luo</i> | |
| Wavelength Division Multiplexing | 606 | | |
| <i>Yassine Khelifi, Noureddine Boudriga, and Mohammad S. Obaidat</i> | | | |
| Part 3: Digital and Optical Networks | | Volume II: LANs, MANs, WANs, The Internet, and Global, Cellular, and Wireless Networks | |
| Digital Communication Basics | 629 | Part 1: LANs, MANs, and WANs | |
| <i>Robert W. Heath and Atul A. Salvekar</i> | | Local Area Networks | 3 |
| Digital Radio Broadcasting | 642 | <i>Wayne C. Summers</i> | |
| <i>Zhuojun Joyce Chen</i> | | Ethernet LANs | 19 |
| Spread Spectrum Signals for Digital Communications | 675 | <i>William Stallings</i> | |
| <i>Filippo Giannetti and Marco Luise</i> | | Token Ring LANs | 27 |
| Optical Fiber Communications | 692 | <i>Norman C. Strole, Werner Bux, and Robert D. Love</i> | |
| <i>Habib Hamam and Sghaier Guizani</i> | | Optical Fiber LANs | 40 |
| Optical Transmitters, Receivers, and Noise | 708 | <i>Mo Adda, Amanda Peart, and Jau Ming Chew</i> | |
| <i>Ken Pedrotti</i> | | Windows 2000 Operating System | 57 |
| Optical Signal Regeneration | 729 | <i>Dario Forte</i> | |
| <i>Mingshan Zhao</i> | | Linux Operating System | 78 |
| Optical Sources | 745 | <i>Mark Shacklette</i> | |
| <i>Tin Win and Serge Demidenko</i> | | Metropolitan Area Networks | 91 |
| Lambda and Sub-Lambda Switching | 767 | <i>Richard J. Nieporent</i> | |
| <i>Mario Baldi and Yoram Ofek</i> | | Terrestrial Wide Area Networks | 116 |
| Optical Cross Connects | 783 | <i>Gurdeep Singh Hura</i> | |
| <i>Wen-De Zhong</i> | | Packet Switching | 136 |
| Optical Memories | 795 | <i>Qinqing Zhang and Qi Bi</i> | |
| <i>Paul W. Nutter</i> | | Circuit Switching | 146 |
| Characterization of Optical Fibers | 815 | <i>Farid Farahmand and Qiong (Jo) Zhang</i> | |
| <i>Liang Chen, John Cameron, and Xiaoyi Bao</i> | | | |
| Optical Couplers and Splitters | 828 | | |
| <i>Kais Dridi, Mustapha Razzak, and Habib Hamam</i> | | | |

| | | | |
|---|------------|--|------------|
| Message Switching | 159 | Voice Over Internet Protocol | 468 |
| <i>Farid Farahmand</i> | | <i>Sherali Zeadally and Farhan Siddiqui</i> | |
| Frame Relay | 172 | Signaling Approaches | 488 |
| <i>Eddie Rabinovitch</i> | | <i>Edmundo Monteiro, Fernando Boavida, Marilia Curado, and Luis Cordeiro</i> | |
| Asynchronous Transfer Mode (ATM) | 183 | Voice over MPLS and VoIP over MPLS | 509 |
| <i>Arjan Durrezi and Raj Jain</i> | | <i>Junaid Ahmed Zubairi</i> | |
| Broadband Integrated Services Digital Network | 200 | Telephone Number Mapping (ENUM) | 519 |
| <i>B. Muthukumarán</i> | | <i>Leslie L. Daigle</i> | |
| DSL (Digital Subscriber Line) | 210 | Web Hosting | 532 |
| <i>Milos Milosevic</i> | | <i>Thomas C. Bressoud</i> | |
| Cable Modems | 221 | End-System QoS | 545 |
| <i>Shaheed N. Mohammed</i> | | <i>Tarek F. Abdelzhaer and Chengdu Huang</i> | |
| Home Networking | 230 | Web Services | 559 |
| <i>Sherali Zeadally</i> | | <i>Mei-Ling L. Liu</i> | |
| Multimedia Networking | 246 | | |
| <i>Hans-Peter Dommel</i> | | | |
| | | | |
| Part 2: The Internet, Global Networks, and VoIP | | Part 3: Cellular and Wireless Networks | |
| The Internet Fundamentals | 267 | Cellular Communications Channels | 579 |
| <i>Hossein Bidgoli</i> | | <i>Aarne Mämmelä and Risto Wichman</i> | |
| History of the Internet | 280 | Cellular Telephony | 591 |
| <i>John Lucas Sherry and Nicholas David Bowman</i> | | <i>Elyes Ben Ali Bdira</i> | |
| Internet2® | 294 | Mobile Radio Communications | 616 |
| <i>Linda Bruenjes and Carolyn Siccama</i> | | <i>Chi Zhou</i> | |
| Internet Domain Name System | 305 | Evolution of Mobile Cellular Networks | 630 |
| <i>Krishna Jayakar</i> | | <i>Jiang Xie and Xiaoyuan Gu</i> | |
| Information Retrieval on the Internet | 320 | Global System for Mobile Communications | 642 |
| <i>Raymond F. Wisman</i> | | <i>Mohamed A. Haleem and Koduvayur P. Subbalakshmi</i> | |
| Internet Architecture | 345 | General Packet Radio Service | 658 |
| <i>Geoffrey G. Xie</i> | | <i>Allen H. Levesque</i> | |
| TCP/IP Suite | 358 | Location Management in Personal Communication Systems | 675 |
| <i>Prabhaker Mateti</i> | | <i>Jingyuan Zhang and Ivan Stojmenovic</i> | |
| SMTP (Simple Mail Transfer Protocol) | 388 | Mobility Management in Heterogeneous Networks | 685 |
| <i>Vladimir V. Riabov</i> | | <i>Guangbin Fan, Xuming Lu, and Song Ci</i> | |
| IP Multicast | 407 | Universal Mobile Telecommunications System | 699 |
| <i>Emilia Rosti</i> | | <i>Faouzi Zarai, Noureddine Boudriga, and Mohammad S. Obaidat</i> | |
| Network QoS | 417 | International Mobile Telecommunications-2000 and 3G Wireless Systems | 716 |
| <i>Ying Lu</i> | | <i>Mustafa M. Matalgah and Omar M. Hammouri</i> | |
| Internet Security Standards | 428 | Code Division Multiple Access (CDMA) | 751 |
| <i>Raymond R. Panko</i> | | <i>Frank H.P. Fitzek and Marcos Katz</i> | |
| Technology and Standards for Low-Bit-Rate Vocoding Methods | 447 | | |
| <i>Miguel Arjona Ramírez and Mário Minami</i> | | | |

| | | | |
|---|-------------|--|-------------|
| Time-Division Multiple Access | 769 | Data Monitoring and Gathering in Sensor Networks | 1113 |
| <i>Tom S. Chan</i> | | <i>Symeon Papavassiliou, Stella Kafetzoglou, and Jin Zhu</i> | |
| Carrier Sense Multiple Access Protocols | 779 | In-Network Data Aggregation in Wireless Sensor Networks | 1131 |
| <i>Wei Ye</i> | | <i>Kemal Akkaya and Ismail Ari</i> | |
| Bluetooth Technology | 790 | Cognitive and Software Defined Radios for Dynamic Spectrum Access | 1147 |
| <i>Brent A. Miller</i> | | <i>Troy Weingart and Douglas C. Sicker</i> | |
| Satellite Communications Basics | 802 | Localization in Wireless Networks | 1158 |
| <i>Michele Luglio and Antonio Saitto</i> | | <i>Slim Rekhis, Noureddine Boudriga, and Mohammad S. Obaidat</i> | |
| Land-Mobile Satellite Channel | 815 | Interference Management in Wireless Networks | 1178 |
| <i>Emilio Matricciani</i> | | <i>Keivan Navaie and Shahrokh Valaee</i> | |
| Geosynchronous Fixed Satellite Communications | 836 | Wireless Wide Area Networks | 1191 |
| <i>Michele Luglio and Antonio Saitto</i> | | <i>Anthony H. Smith and Raymond A. Hansen</i> | |
| Satellites in IP Networks | 860 | Wireless Broadband Access | 1200 |
| <i>Fatih Alagöz and Abbas Jamalipour</i> | | <i>Hsiao-Hwa Chen and Mohsen Guizani</i> | |
| Global Navigation Satellite Systems | 877 | Indoor Wireless Infrared Communications | 1223 |
| <i>Omar Al-Bayari and Balqies Sadoun</i> | | <i>Z. Ghassemlooy</i> | |
| Wireless LANs | 896 | | |
| <i>Mohammad S. Obaidat, G. I. Papadimitriou, and S. Obeidat</i> | | | |
| Wireless LAN Standards | 917 | | |
| <i>Prashant Krishnamurthy</i> | | | |
| Bit-Interleaved Coded Modulation | 935 | | |
| <i>Yuheng Huang and James A. Ritcey</i> | | | |
| The Wireless Application Protocol | 955 | | |
| <i>Lillian N. Cassel and Arun Srinivasa Murthy</i> | | | |
| Wireless ATM | 972 | | |
| <i>Amel Meddeb and Noureddine Boudriga</i> | | | |
| Wireless IP Telephony | 991 | | |
| <i>Manish Marwah and Shivakant Mishra</i> | | | |
| Wireless Internet | 1000 | | |
| <i>Abbas Jamalipour</i> | | | |
| Internetworking of Heterogeneous Wireless Networks | 1018 | | |
| <i>Sherali Zeadally and Farhan Siddiqui</i> | | | |
| Principles and Applications of Ad Hoc and Sensor Networks | 1040 | | |
| <i>Marco Conti</i> | | | |
| Medium Access in Ad Hoc and Sensor Networks | 1057 | | |
| <i>Vojislav B. Mišić and Jelena Mišić</i> | | | |
| Emerging Trends in Routing Protocols in Mobile Wireless Ad Hoc and Sensor Networks | 1084 | | |
| <i>Jamal N. Al-Karaki</i> | | | |
| Broadcasting in Ad Hoc and Sensor Networks | 1101 | | |
| <i>François Ingelrest, David Simplot-Ryl, Hong Guo, and Ivan Stojmenović</i> | | | |
| | | Volume III: Distributed Networks, Network Planning, Control, Management, and New Trends and Applications | |
| | | Part 1: Distributed Networks | |
| | | Client/Server Computing Basics | 3 |
| | | <i>Daniel McFarland and Darren B. Nicholson</i> | |
| | | Groupware | 16 |
| | | <i>Robert Slagter</i> | |
| | | Network Middleware | 33 |
| | | <i>Linda Volonino and Pragati Dalal</i> | |
| | | Grid Computing Fundamentals | 45 |
| | | <i>Mark Baker</i> | |
| | | Grid Computing Implementation | 63 |
| | | <i>Barry Wilkinson and Clayton Ferner</i> | |
| | | Cluster Computing Fundamentals | 79 |
| | | <i>Hong Ong and Mark Baker</i> | |
| | | Next-Generation Cluster Networks | 93 |
| | | <i>Keren Bergman, Benjamin A. Small, and Larry A. Bergman</i> | |
| | | Utility Computing on Global Grids | 110 |
| | | <i>Chee Shin Yeo, Rajkumar Buyya, Marcos Dias de Assunção, Jia Yu, Anthony Sulistio, Srikumar Venugopal, and Martin Placek</i> | |

| | | | |
|---|------------|--|------------|
| Peer-to-Peer Network Architecture | 131 | Computer Viruses and Worms | 440 |
| <i>Jing Wu and Michel Savoie</i> | | <i>Robert Slade</i> | |
| Peer-to-Peer Network Applications | 152 | Denial of Service Attacks | 454 |
| <i>Stan Kurkovsky</i> | | <i>Qijun Gu and Peng Liu</i> | |
| Incentive Issues in Peer-to-Peer Systems | 168 | E-Mail Threats and Vulnerabilities | 469 |
| <i>Yu-Kwong Kwok</i> | | <i>David Harley</i> | |
| Storage Area Network Fundamentals | 189 | Virtual Private Networks | 488 |
| <i>Vladimir V. Riabov</i> | | <i>G. I. Papadimitriou, M. S. Obaidat, C. Papazoglou, and A.S.Pomportsis</i> | |
| Fiber Channel | 205 | Cryptography | 505 |
| <i>Jiying Zhao</i> | | <i>Ari Juels</i> | |
| Storage Area Networks: Architectures and Protocols | 217 | Access Control | 518 |
| <i>Nirwan Ansari and Si Yin</i> | | <i>Sabrina De Capitani di Vimercati, Sara Foresti, Stefano Paraboschi, and Pierangela Samarati</i> | |
| Distributed Intelligent Networks | 235 | Biometrics | 539 |
| <i>G. N. Prezerakos and I. S. Venieris</i> | | <i>James L. Wayman</i> | |
| Smart Cards: Communication Protocols and Applications | 251 | Firewalls | 553 |
| <i>Michael Tunstall, Konstantinos Markantonakis, Damien Sauveron, and Keith Mayes</i> | | <i>James E. Goldman</i> | |
| Fault-Tolerant Systems | 269 | Authentication | 570 |
| <i>Amiya Nayak</i> | | <i>Patrick McDaniel</i> | |
| Distributed Algorithms | 286 | Password Authentication | 581 |
| <i>Valmir C. Barbosa</i> | | <i>Jeremy L. Rasmussen</i> | |
| Distributed Databases | 298 | Physical Security Threats and Measures | 596 |
| <i>David Coquil and Harald Kosch</i> | | <i>Mark Michael</i> | |
| Part 2: Network Planning, Control, and Management | | Computer Security Incident Response Teams (CSIRTs) | 632 |
| Network Capacity Planning | 315 | <i>Raymond R. Panko</i> | |
| <i>Priscilla Oppenheimer</i> | | Backup and Recovery System Requirements | 639 |
| Network Traffic Modeling | 326 | <i>David R. Reavis</i> | |
| <i>Thomas M. Chen</i> | | Business Requirements of Backup Systems | 650 |
| Network Traffic Management | 340 | <i>Markus Klemen, Thomas Neubauer, and Edgar R. Weippl</i> | |
| <i>Thomas M. Chen</i> | | Evaluating Storage Media Requirements | 662 |
| Network Security Risk Assessment and Management | 354 | <i>David R. Reavis</i> | |
| <i>Dan Port, Rick Kazman, and David Klappholz</i> | | Business Continuity Planning | 671 |
| Network Reliability and Fault Tolerance | 372 | <i>Marco Cremonini and Pierangela Samarati</i> | |
| <i>Matthew Liotine</i> | | E-Mail and Internet Use Policies | 689 |
| Social Engineering | 384 | <i>Nancy J. King</i> | |
| <i>Benjamin Böck, Markus D. Klemen, and Edgar R. Weippl</i> | | Computer Network Management | 714 |
| Intrusion-Detection Systems | 403 | <i>Jian Ren</i> | |
| <i>Peng Ning and Sushil Jajodia</i> | | Part 3: Computer Network Popular Applications and Future Directions | |
| Network Attacks | 421 | E-mail and Instant Messaging | 733 |
| <i>Mohamed Hamdi and Noureddine Boudriga</i> | | <i>Bhagyavati</i> | |

| | | | |
|--|------------|---|-------------|
| Application Service Providers (ASPs) <i>Bandula Jayatilaka</i> | 742 | Mobile Commerce <i>Vijay Atluri</i> | 915 |
| Videoconferencing <i>Ketan Mayer-Patel</i> | 755 | Online News <i>Bruce Garrison and Marcus Messner</i> | 927 |
| Computer Conferencing: Protocols and Applications <i>William R. Gillis and Colleen Taugher</i> | 768 | Travel and Tourism <i>Ulrike Gretzel, Youcheng Wang, and Daniel R. Fesenmaier</i> | 943 |
| Telecommuting and Telework <i>Michael Workman</i> | 777 | Web-Based Training <i>Patrick J. Fahy</i> | 962 |
| Online Banking <i>Ronnie J. Phillips</i> | 791 | RFID (Radio-Frequency Identification) <i>Stephen A. Weis</i> | 974 |
| Digital Libraries <i>Cavan McCarthy</i> | 801 | Active Networking <i>Stephen F. Bush</i> | 985 |
| Computer Conferencing and Distance Learning <i>Liam Rourke and Heather Kanuka</i> | 831 | Applications of Biological Concepts to Designs of Computer Networks and Network Applications <i>Tatsuya Suda, Tadashi Nakano, and Keita Fujii</i> | 1012 |
| Electronic Commerce <i>Charles Steinfield</i> | 843 | Nanotechnology for Communication Systems <i>Syed H. Murshid and Azhar M. Khayrattee</i> | 1022 |
| Electronic Data Interchange (EDI) <i>Matthew K. McGowan</i> | 860 | Molecular Communication: New Paradigm for Communication among Nanoscale Biological Machines <i>Michael Moore, Akihiro Enomoto, Tatsuya Suda, Tadashi Nakano, and Yutaka Okaie</i> | 1034 |
| Electronic Payment Systems <i>Indrajit Ray</i> | 869 | | |
| Internet Relay Chat (IRC) <i>James M. Hudson and Paul L. Witt</i> | 889 | | |
| Online Communities <i>Lee Sproull and Manuel Arriaga</i> | 898 | | |