



1st ed., 1169 pp.

Edited by:

Biswanath Mukherjee

University of California, Davis, USA bmukherjee@ucdavis.edu

Ioannis Tomkos

Athens Information Technology Center, Greece itom@ait.gr

Massimo Tornatore

Politecnico di Milano, Italy massimo.tornatore@polimi.it

Peter Winzer

Nubis Communications, USA peter.winzer@ieee.com

Yongli Zhao

Beijing University of Posts and Telecommunications, China yonglizhao@bupt.edu.cn



B. Mukherjee, I. Tomkos, M. Tornatore, P. Winzer, Y. Zhao (eds.)

Springer Handbook of Optical Networks

"This handbook is the most authoritative compendium of optical networking fundamentals, and provides both beginner and seasoned practitioners an instant guide to the latest technologies and best practices across applications ranging from core and access networks to datacenter and high performance computing networks." – Vijay Vusirikala - Head of Network Architecture and Optical Engineering, Google, USA

- o Offers a definitive reference for practitioners, researchers, and students in optical networks
- o Represents a collective effort of over 100 top-level scientists from around the world
- o Comprehensively treats the ever-growing field that represents the backbone of the internet

This handbook is an authoritative, comprehensive reference on optical networks, written for practitioners, researchers, and students around the world. This book provides a definitive single point of reference for all those interested to find out information about the basic technologies and approaches that are used to design and deploy optical communication networks across a vast variety of different application fields spanning from datacenters to backbone and access networks.

The book is divided into four parts, each edited by top experts in the field. The parts include: Optical Subsystems for Transmission and Switching; Core Networks; Datacenter and Super-computer Networking; Optical Access and Wireless Networks. The contributors are leading authorities in the fields of engineering and represent academia, industry, and international government and regulatory agencies.

Springer Handbooks are premium products within our book program. They are prepared with great care and provide concise compilation of approved key information on methods of research, functional relationships, and general principles in well-selected fields of physical and applied science and technology.

Springer Handbooks give fast and comprehensive overview and allow easy retrieval of essential information, as well as references to extensive resources.



Springer Handbook of Optical Networks

"This handbook will be an extremely valuable addition to any serious professional or student in the field of optical networks. The handbook is edited and authored by prominent leading experts in the field, and it insightfully covers the wide gamut of important multidisciplinary topics." – Alan Willner, University of Southern California, USA; past President of the IEEE Photonics Society and of the Optical Society of America (OSA)

"This will be the authority in handbooks of modern optical communication and networking, offering the fundamental knowledge to bridge a gap between physical and cyber layers." – Shu Namiki – Research Director, National Institute of Advanced Industrial Science and Technology (AIST), Japan

Table of Contents

R. Alferness (UC Santa Barbara): The evolution of optical networks

Part A: Optical Subsystems for Transmission and Switching

- T. Sasaki (Innovation Core SEI), T. Hasegawa & H. Ishikawa (Sumitomo Electric Industries): Optical fiber and cables
- M. Vasilyev (University of Texas at Arlington), S. Radic (UC San Diego): Optical amplifiers
- G. Bosco (Politecnico di Torino), J. Elbers (ADVA Optical Networking): Optical transponders
- X. Chen & S. Chandrasekhar (Nokia Bell Labs): Optical transponder components
- S. Savory (University of Cambridge), D. Millar (Mitsubishi Electric Research Labs): Digital signal processing (DSP) for optical transponders
- A. Graell i Amat (Chalmers University of Technology), L. Schmalen (KIT): Forward Error Correction for optical transponders
- B. Collings (Lumentum), M. Filer (Microsoft): Optical node architectures
- A. Bononi (Univeristy of Parma), R. Dar (Nokia Bell Labs), M. Secondini (Sant'Anna School of Advanced Studies), O. Serena (University
 of Parma), P. Poggiolini (Politecnico di Torino): Fiber nonlinearity and optical system performance
- R. Ryf (Nokia Bell Labs), C. Antonelli (University of L'Aquila): Space-division multiplexing (SDM)

Part B: Core Networks

- R. Doverspike (Network Evolution Strategies): Carrier network architectures and resiliency
- S. Trowbridge (Nokia): Standards for optical transport networks
- J. Simmons (Monarch Network Architects), G. Rouskas (North Carolina State University): Routing and wavelength (spectrum) assignment
- R. Dutta (North Carolina State University), H. Harai (National Institute of Information and Communications Technology): Traffic grooming
- M. Chamania (ADVA Optical Networking), A. Jukan (TU Braunschweig): Dynamic control of optical networks
- S. Subramaniam (George Washington University), K. Kondepu & A. Marotta (Sant'Anna School of Advanced Studies): Cross-layer design
- J. Zhang (Beijing University of Posts and Telecommunications), R. Vialta (Centre Tecnològic Telecomunicacions Catalunya), X. Yu (Beijing University of Posts and Telecommunications), V. Lopez (Telefonica), A. Aguado (Universidad Politecnica de Madrid): Optical network virtualization
- A. Gumaste (Indian Institute of Technology, Bombay): Metropolitan networks
- D. Kilper (University of Arizona): Energy efficiency in optical networks
- C. Qiao (University of Buffalo), D. Chiaroni (Nokia Bell Labs), P. Argibay-Losada (SBI BITS): Optical packet switching and optical burst switching

Part C: Datacenter and Super-Computer Networking

- H. Liu, R. Urata, X. Zhou & A. Vahdat (Google): Evolving requirements and trends of datacenters networks
- S. Rumley & K. Bergman (Columbia University), A. Seyedi & M. Fiorentino (Hewlett Packard Enterprise): Evolving requirements and trend of HPC
- R. Proietti, P. Fotouhi, S. Werner & S. Yoo (UC Davis): Intra-Datacenter network architectures
- B. Booth (Microsoft), D. Piehler (Dell EMC): System aspects for optical interconnect transceivers
- N. Calabretta (Technical University Eindhoven), N. Parsons (HUBER+SUHNER Polatis): Optical switching for Data Center Networks

Part D: Optical Access and Wireless Networks

- B. Skubic (Ericsson), L. Wosinska (KTH): Introduction to optical access networks
- D. Van Veen (Nokia Bell Labs), J. Kani (NTT): Current TDM-PON flavors
- J. Prat (Universitat Politecnica de Catalunya), L. Valcarenghi (Sant'Anna School of Advanced Studies): Emerging PONs
- T. Pfeiffer (Nokia Bell Labs): Advanced PON architectures
- P. Townsend (Tyndall National Institute), D. Payne (Trinity College of Dublin), G. Talli (Tyndall National Institute), M. Ruffini & A. Hill (Trinity College Dublin): Long-reach PON and access/metro integration
- F. Cavaliere (Ericsson), D. Larrabeiti (Universitdad Carlos III de Madrid): Digital optical front-haul technologies and architectures
- J. Mitchell (University College London): Analog optical front-haul technologies and architectures
- G. Chang (Georgia Institute of Technology): Optical networking for 5G and fiber-wireless convergence
- A. Carrasco-Casado (National Institute of Information and Communications Technology), R. Mata Calvo (German Aerospace Center): Free-space optical links for communication networks
- X. Lin & T. Matsumura (Nakagawa Laboratories): Visible light communications
- A. Behbahani (US Air Force Research Laboratory), M. Pakmehr (OptoXense), W. Stange (Universal Technologies Corp.): Optical communications for avionics and autonomous vehicles