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The Only Resource to Cover Wireless, Wireline, and OpticalNetworks in One Volume Mobile and stationary next-generation networks that access thephotonic core are destined to become as ubiquitous as traditionaltelephone networks. These networks must efficiently provideadequate network quality to multimedia applications with highbandwidth and strict quality-of-service requirements, as well asseamlessly integrate mobile and fixed architectures. Today'sengineering students must be properly prepared to meet thechallenges of next-generation network development anddeployment. Featuring contributions from top industrial experts and academicprofessors, this authoritative work provides a comprehensiveintroduction to next-generation networks. It explains wirelessnetworks such as wireless local area networks (WLAN), wirelesspersonal area networks (WPAN), wireless access, 3G/4G cellular, andRF transmission, as well as optical networks like long-haul andmetropolitan networks, optical fiber, photonic devices, and VLSIchips. Rather than focusing on heavy math or physical details, thisresource explores how the technology is being used. It describesaccess and transport network layer technologies while alsodiscussing the network and services aspects. Chapter coverage includes: Fiber–wireless networks: technologies, architectures, andfuture challenges Packet backhaul network Point-to-point microwave backhaul Fourth-generation broadband: paving the road to Gbit/s withcopper Dynamic bandwidth allocation in EPON and GPON Next-generation ethernet passive optical networks: 10G-EPON Power line communications and smart grids Signaling for multimedia conferencing in 4G: architecture,evaluation, and issues Self-coexistence and security in cognitive radio networks Mobile WiMAX UWB personal area networks—MIMO extensions Next-generation integrated metropolitan-access network:technology integration and wireless convergence Resilient burst ring: a novel technology for the next-generationmetropolitan area networks Filled with illustrations and practical examples from industry,this book will be invaluable to engineers and researchers inindustry and academia, as well as senior undergraduate and graduatestudents, marketing and management staff, photonics physicists, andchip designers.

Throughout the world, there is an increasing demand on diminishing natural resources in the industrial, transport, commercial, and residential sectors. Of these, the residential sector uses the most energy on such needs as lighting, water heating, air conditioning, space heating, and refrigeration. This sector alone consumes one-third of the total primary energy resources available. By using green building and smart automation techniques, this demand for energy resources can be lowered. Green Building Management and Smart Automation is an essential scholarly publication that provides an in-depth analysis of design technologies for green building and highlights the smart automation technologies that help in energy conservation, along with various performance metrics that are necessary to facilitate a building to be known as a “Green Smart Building.” Featuring a range of topics such as environmental quality, energy management, and big data analytics, this book is ideal for researchers, engineers, policymakers, government officials, architects, and students.

This comprehensive handbook serves as a professional reference as well as a practitioner's guide to today's most complete and concise view of nanoscale networking and communications. It offers in-depth coverage of theory, technology, and practice as they relate to established technologies and recent advancements. It explores practical solutions to a wide range of nanoscale networking and communications issues. Individual chapters, authored by leading experts in the field, address the immediate and long-term challenges in the authors' respective areas of expertise.

Fiber Optic Measurement Techniques is an indispensable collection of key optical measurement techniques essential for developing and characterizing today’s photonic devices and fiber optic systems. The book gives comprehensive and systematic descriptions of various fiber optic measurement methods with the emphasis on the understanding of optoelectronic signal processing methodologies, helping the reader to weigh up the pros and cons of each technique and establish their suitability for the task at hand. Carefully balancing descriptions of principle, operations and optoelectronic circuit implementation, this indispensable resource will enable the engineer to: Understand the implications of various measurement results and system performance qualifications Characterize modern optical systems and devices Select optical devices and subsystems in optical network design and implementation Design innovative instrumentations for fiber optic systems This book brings together in one volume the fundamental principles with the latest techniques, making it a complete resource for the optical and communications engineer developing future optical devices and fiber optic systems. "Optical fiber communication systems and networks constitute the core of the telecom infrastructure of the information society worldwide. Accurate knowledge of the properties of the contituent components, and of the performance of the subsystems and systems must be obtained in order to ensure reliable transmission, distribution, and delivery of information. This book is an authoritative and comprehensive treatment of fiber-optic measurement techniques, including not only fundamental principles and methodologies but also various instrumentations and practical implementations. It is an excellent up-to-date resource and reference for the academic and industrial researcher as well as the field engineer in manufacturing and network operations." –Dr. Tingye Li, AT&T Labs (retired) Rongqing Hui received his PhD in Electrical Engineering from Politecnico di Torino, Italy in 1993. He is currently a tenured professor in the department of Electrical Engineering and Computer Science at the University of Kansas. He has published more than 90 refereed technical papers in the area of fiber-optic communications and holds 13 patents. Dr. Hui currently serves as an Associate Editor of IEEE Transactions on Communications. Maurice O'Sullivan has worked for Nortel for a score of years, at first in the optical cable business, developing factory-tailored metrology for optical fiber, but, in the main, in the optical transmission business developing, modeling and verifying physical layer designs & performance of Nortel's line and highest rate transmission product including OC-192, MOR, MOR+, LH1600G, eDCO and eDC40G. He holds a Ph.D. in physics (high resolution spectroscopy) from the University of Toronto, is a Nortel Fellow and has been granted more than 30 patents. The only book to combine explanations of the basic principles with latest techniques to enable the engineer to develop photonic systems of the future Careful and systematic presentation of measurement methods to help engineers to choose the most appropriate for their application The latest methods covered, such as real-time optical monitoring and phase coded systems and subsystems, making this the most up-to-date guide to fiber optic measurement on the market

In our abundant computing infrastructure, performance improvements across most all application spaces are now severely limited by the energy dissipation involved in processing, storing, and moving data. The exponential increase in the volume of data to be handled by our computational infrastructure is driven in large part by unstructured data from countless sources. This book explores revolutionary device concepts, associated circuits, and architectures that will greatly extend the practical engineering limits of energy-efficient computation from device to circuit to system level. With chapters written by international experts in their

corresponding field, the text investigates new approaches to lower energy requirements in computing. Features • Has a comprehensive coverage of various technologies • Written by international experts in their corresponding field • Covers revolutionary concepts at the device, circuit, and system levels

This chapter introduces optical interconnects as a possible solution to the emerging performance wall in high-density supercomputer applications, arising from limited bandwidth and density of on-chip interconnects and chip-to-chip (processor-to-memory) electrical interfaces. The chapter focuses on the translation of system and link level performance metrics to photonic component requirements. The topics to be developed include the network topology, photonic link components, circuit and system design for photonic links.

This book explores up-to-date research trends and achievements on low-power and high-speed technologies in both electronics and optics. It offers unique insight into low-power and high-speed approaches ranging from devices, ICs, sub-systems and networks that can be exploited for future mobile devices, 5G networks, Internet of Things (IoT), and data centers. It collects heterogeneous topics in place to catch and predict future research directions of devices, circuits, subsystems, and networks for low-power and higher-speed technologies. Even it handles about artificial intelligence (AI) showing examples how AI technology can be combined with concurrent electronics. Written by top international experts in both industry and academia, the book discusses new devices, such as Si-on-chip laser, interconnections using graphenes, machine learning combined with CMOS technology, progresses of SiGe devices for higher-speed electronices for optic, co-design low-power and high-speed circuits for optical interconnect, low-power network-on-chip (NoC) router, X-ray quantum counting, and a design of low-power power amplifiers. Covers modern high-speed and low-power electronics and photonics. Discusses novel nano-devices, electronics & photonic sub-systems for high-speed and low-power systems, and many other emerging technologies like Si photonic technology, Si-on-chip laser, low-power driver for optic device, and network-on-chip router. Includes practical applications and recent results with respect to emerging low-power systems. Addresses the future perspective of silicon photonics as a low-power interconnections and communication applications.

This books aims to present fundamental aspects of optical communication techniques and advanced modulation techniques and extensive applications of optical communications systems and networks employing single-mode optical fibers as the transmission system. New digital techqniues such as chromatic dispersion, polarization mode dispersion, nonlinear phase distortion effects, etc. will be discussed. Practical models for practice and understanding the behavior and dynamics of the devices and systems will be included.

Since its first volume in 1960, Advances in Computers has presented detailed coverage of innovations in computer hardware, software, theory, design, and applications. It has also provided contributors with a medium in which they can explore their subjects in greater depth and breadth than journal articles usually allow. As a result, many articles have become standard references that continue to be of sugnificant, lasting value in this rapidly expanding field. In-depth surveys and tutorials on new computer technology Well-known authors and researchers in the field Extensive bibliographies with most chapters Many of the volumes are devoted to single themes or subfields of computer science

This book is volume III of a series of books on silicon photonics. It reports on the development of fully integrated systems where many different photonics component are integrated together to build complex circuits. This is the demonstration of the fully potentiality of silicon photonics. It contains a number of chapters written by engineers and scientists of the main companies, research centers and universities active in the field. It can be of use for all those persons interested to know the potentialities and the recent applications of silicon photonics both in microelectronics, telecommunication and consumer electronics market.

The huge progress which has been achieved in the field is covered here, in the first comprehensive monograph on vertical-cavity surface-emitting lasers (VCSELs) since eight years. Apart from chapters reviewing the research field and the laser fundamentals, there are comprehensive updates on red and blue emitting VCSELs, telecommunication VCSELs, optical transceivers, and parallel-optical links for computer interconnects. Entirely new contributions are made to the fields of vectorial three-dimensional optical modeling, single-mode VCSELs, polarization control, polarization dynamics, very-high-speed design, high-power emission, use of high-contrast gratings, GaInNAsSb long-wavelength VCSELs, optical video links, VCSELs for optical mice and sensing, as well as VCSEL-based laser printing. The book appeals to researchers, optical engineers and graduate students.

An up-to-date, comprehensive guide for advanced electrical engineering studentsand electrical engineers working in the IC and optical industries This book covers the major transimpedance amplifier (TIA) topologies and their circuit implementations for optical receivers. This includes the shunt-feedback TIA, common-base TIA, common-gate TIA, regulated-cascode TIA, distributed-amplifier TIA, nonresistive feedback TIA, current-mode TIA, burst-mode TIA, and analog-receiver TIA. The noise, transimpedance, and other performance parameters of these circuits are analyzed and optimized. Topics of interest include post amplifiers, differential vs. single-ended TIAs, DC input current control, and adaptive transimpedance. The book features real-world examples of TIA circuits for a variety of receivers (direct detection, coherent, burst-mode, etc.) implemented in a broad array of technologies (HBT, BiCMOS, CMOS, etc.). The book begins with an introduction to optical communication systems, signals, and standards. It then moves on to discussions of optical fiber and photodetectors. This discussion includes p-i-n photodetectors; avalanche photodetectors (APD); optically preamplified detectors; integrated detectors, including detectors for silicon photonics; and detectors for phase-modulated signals, including coherent detectors. This is followed by coverage of the optical receiver at the system level: the relationship between noise, sensitivity, optical signal-to-noise ratio (OSNR), and bit-error rate (BER) is explained; receiver impairments, such as intersymbol interference (ISI), are covered. In addition, the author presents TIA specifications and illustrates them with example values from recent product data sheets. The book also includes: Many numerical examples throughout that help make the material more concrete for readers Real-world product examples that show the performance of actual IC designs Chapter summaries that highlight the key points Problems and their solutions for readers who want to practice and deepen their understanding of the material Appendices that cover communication signals, eye diagrams, timing jitter, nonlinearity, adaptive equalizers, decision point control, forward error correction (FEC), and second-order low-pass transfer functions Analysis and Design of Transimpedance Amplifiers for Optical Receivers belongs on the reference shelves of every electrical engineer working in the IC and optical industries. It also can serve as a textbook for upper-level undergraduates and graduate students studying integrated circuit design and optical communication.

This comprehensive handbook gives a fully updated guide to lasers and laser technologies, including the complete range of their technical applications. This forth volume covers laser applications in the medical, metrology and communications fields. Key Features: • Offers a complete update of the original, bestselling work, including many brand-new chapters. • Deepens the introduction to fundamentals, from laser design and fabrication to host matrices for solid-state lasers, energy level diagrams, hosting materials, dopant energy levels, and lasers based on nonlinear effects. • Covers new laser types, including quantum cascade lasers, silicon-based lasers, titanium sapphire lasers, terahertz lasers, bismuth-doped fiber lasers, and diode-pumped alkali lasers. • Discusses the latest applications, e.g., lasers in microscopy, high-speed imaging, attosecond metrology, 3D printing, optical atomic clocks, time-resolved spectroscopy, polarization and profile measurements, pulse measurements, and laser-induced fluorescence detection. • Adds new sections on laser materials processing, laser spectroscopy, lasers in imaging, lasers in environmental sciences, and lasers in communications. This handbook is the ideal companion for

scientists, engineers, and students working with lasers, including those in optics, electrical engineering, physics, chemistry, biomedicine, and other relevant areas.

As rapid technological developments occur in electronics, photonics, mechanics, chemistry, and biology, the demand for portable, lightweight integrated microsystems is relentless. These devices are getting exponentially smaller, increasingly used in everything from video games, hearing aids, and pacemakers to more intricate biomedical engineering and military applications. Edited by Kris Iniewski, a revolutionary in the field of advanced semiconductor materials, Integrated Microsystems: Electronics, Photonics, and Biotechnology focuses on techniques for optimized design and fabrication of these intelligent miniaturized devices and systems. Composed of contributions from experts in academia and industry around the world, this reference covers processes compatible with CMOS integrated circuits, which combine computation, communications, sensing, and actuation capabilities. Light on math and physics, with a greater emphasis on microsystem design and configuration and electrical engineering, this book is organized in three sections—Microelectronics and Biosystems, Photonics and Imaging, and Biotechnology and MEMs. It addresses key topics, including physical and chemical sensing, imaging, smart actuation, and data fusion and management. Using tables, figures, and equations to help illustrate concepts, contributors examine and explain the potential of emerging applications for areas including biology, nanotechnology, micro-electromechanical systems (MEMS), microfluidics, and photonics.

"The ever-growing demand for bandwidth in data centers and supercomputers has significantly increased the need for high-speed, low-cost, and energy-efficient short-range optical interconnects. This thesis presents several research outcomes towards designing energy-efficient and cost-effective short-reach optical interconnects. First, it studies existing hardware implementations of optical soft-decision forward error correction (SD-FEC) receivers in the literature. Then, it presents a novel methodology for analyzing the decoding performance of multi-branch configurations of SD-FEC receivers. The proposed methodology allows prediction of the impact of a receiver's configuration on its decoding performance. Second, it explores vertical germanium photodetectors and short wavelength silicon photodetectors (Si-PDs) to develop power-efficient high-speed photodetectors. It details an innovative methodology for maximizing the responsivity of a high-speed vertical Ge-PD. The resulting Ge-PD provides a responsivity of 1.09 A/W at 1550 nm, a dark current of 3.5 ?A, and bandwidth of 42.5 GHz at 2 V reverse-bias voltage. Further, it demonstrates the design, fabrication, and measurement results of four novel grating-assisted silicon photodetectors (Si-PD) for 850 nm applications fabricated in silicon-on-insulator (SOI) technology. The optimized design of the grating-assisted Si-PD has a responsivity of 0.3 A/W, an avalanche gain of 6, a dark current of 2 ?A, and bandwidth of 16.4 GHz at 14 V reverse-bias voltage. It also shows an open eye diagram at 35 Gb/s data rate, which to the best of our knowledge, is the fastest operation speed reported for this type of detectors. Third, this thesis presents the design and experimental results of a novel low-power and compact 25 Gb/s optical receiver in 65 nm TSMC technology. It is prototyped with the previously-proposed optimized design of a grating-assisted Si-PD. The proposed optical receiver has a transimpedance gain of 69.4 dB?, a bandwidth of 13.6 GHz, and an input-referred noise of 3.28 ?Arms. It occupies only 0.0056 mm^2 and consumes 30.8 mW at 1.1 V supply voltage. It has an energy efficiency of 1.23 pJ/bit at 25 Gb/s bit rate with an input sensitivity of 54 ?Ap-p for bit error rate (BER) of 10^(-12)." --

This dissertation provides the first systematic analysis of the dynamic energy efficiency of vertical-cavity surface-emitting lasers (VCSELs) for optical interconnects, a key technology to address the pressing ecological and economic issues of the exponentially growing energy consumption in data centers. Energy-efficient data communication is one of the most important fields in “Green Photonics” enabling higher bit rates at significantly reduced energy consumption per bit. In this thesis the static and dynamic properties of GaAs-based oxide-confined VCSELs emitting at 850 nm and 980 nm are analyzed and general rules for achieving energy-efficient data transmission using VCSELs at any wavelength are derived. These rules are verified in data transmission experiments leading to record energy-efficient data transmission across a wide range of multimode optical fiber distances and at high temperatures up to 85°C. Important trade-offs between energy efficiency, temperature stability, modulation bandwidth, low current-density operation and other VCSEL properties are revealed and discussed.

This book describes technology used for effective sensing of our physical world and intelligent processing techniques for sensed information, which are essential to the success of Internet of Things (IoT). The authors provide a multidisciplinary view of sensor technology from materials, process, circuits, to big data domains and they showcase smart sensor systems in real applications including smart home, transportation, medical, environmental, agricultural, etc. Unlike earlier books on sensors, this book provides a “global” view on smart sensors covering abstraction levels from device, circuit, systems, and algorithms.

Die Bundesregierung beschloss bis zum Jahre 2025 die Schaffung einer Gigabit-fähigen Infrastruktur. Das erfordert enorme Anstrengungen im Breitbandausbau der Fernnetze, aber auch bei der Realisierung größerer Übertragungsbandbreiten in der Fläche (vom Stadtnetz bis zum Teilnehmer). Große Streckenlängen und hohe Datenraten können nur mit Lichtwellenleitern realisiert werden. Nur der Lichtwellenleiter ermöglicht eine Infrastruktur, die die Anforderungen der nächsten Jahrzehnte erfüllt. Das Buch gibt eine Einführung in die Lichtwellenleiter-Technik. Der Stoff wird theoretisch fundiert aufbereitet, dann wird der Bogen gespannt bis hin zu konkreten praktischen Beispielen und Anwendungen. Der Leser kann den Stoff unmittelbar auf seine Problemstellungen anwenden. Eine Vielzahl neuer Aspekte sind berücksichtigt, wie aktuelle Normen, neue Fasertypen, Fiber-to-the-Home/Building, Mehrkanalübertragung über MPO/MTP-Stecker, Planung unter Berücksichtigung von Dispersionseffekten, neue Aspekte bei der Faserherstellung, Trends der lösbaren und nichtlösbaren Verbindungstechnik sowie Trends bei der Entwicklung und beim Einsatz von Transceivern, aktualisierte Messvorschrift der Deutschen Telekom zur Messung an FTTH-Netzen.

This book is based on a series of conferences on Wireless Communications, Networking and Applications that have been held on December 27-28, 2014 in Shenzhen, China. The meetings themselves were a response to technological developments in the areas of wireless communications, networking and applications and facilitate researchers, engineers and students to share the latest research results and the advanced research methods of the field. The broad variety of disciplines involved in this research and the differences in approaching the basic problems are probably typical of a

developing field of interdisciplinary research. However, some main areas of research and development in the emerging areas of wireless communication technology can now be identified. The contributions to this book are mainly selected from the papers of the conference on wireless communications, networking and applications and reflect the main areas of interest: Section 1 - Emerging Topics in Wireless and Mobile Computing and Communications; Section 2 - Internet of Things and Long Term Evolution Engineering; Section 3 - Resource Allocation and Interference Management; Section 4 - Communication Architecture, Algorithms, Modeling and Evaluation; Section 5 - Security, Privacy, and Trust; and Section 6 - Routing, Position Management and Network Topologies.

Compiling the most influential papers from the IEICE Transactions in Communications, High-Performance Backbone Network Technology examines critical breakthroughs in the design and provision of effective public service networks in areas including traffic control, telephone service, real-time video transfer, voice and image transmission for a content delivery network (CDN), and Internet access. The contributors explore system structures, experimental prototypes, and field trials that herald the development of new IP networks that offer quality-of-service (QoS), as well as enhanced security, reliability, and function. Offers many hints and guidelines for future research in IP and photonic backbone network technologies

Optical Fiber Telecommunications, Volume Eleven, covers the latest in optical fiber communications and their potential to penetrate and complement other forms of communication, such as wireless access, on-premises networks, interconnects and satellites. This updated edition of this classic, first published in 1979, examines opportunities for future optical fiber technology by presenting the latest advances on key topics, such as 5G wireless access, inter and intra data center communications, THz technologies, secure communications, and free space digital optical links. Topics of note include sections on foundries for widespread user access, designing photonic integrated circuits (PICs), monolithic and hybrid integration technologies, nanophotonics, and advanced and non-conventional data modulation formats. The traditional emphasis of achieving higher data rates and longer transmission distances are also addressed through chapters on space-division-multiplexing using multimode and multicore fibers, undersea cable systems, and reconfigurable networking. This book is an indispensable reference on the latest advances in key technologies for future fiber optic communications. It is suitable for university and industry researchers, graduate students, optical systems implementers, network operators, managers and investors. Updated edition presents the latest advances in optical fiber components, systems, subsystems and networks Written by leading authorities from academia and industry Gives a self-contained overview of specific technologies, covering both the state-of-the-art and future research challenges

Providing straightforward practical guidance, this highly accessible resource presents today's most advanced topics on photonic communications. You get the latest details on 5th generation photonic systems that can be readily applied to your projects in the field. Moreover, the book provides valuable, time-saving tools for network simulation and modeling. You find in-depth coverage of optical signal transmission systems and networks. The book includes coverage of a wide range of critical methods and techniques, such as MIMO (multiple-input and multiple-output), OFDM (Orthogonal frequency-division multiplexing), and advanced modulation and coding. You find detailed discussions on the basic principles and applications of high-speed digital signal processing. Other key topics include advanced concepts on coded-modulation, turbo equalization, polarization-time coding, spatial-domain-based modulation and coding, and multidimensional signaling. This comprehensive book includes a complete set of problems at the end of each chapter to help you master the material.

Vertical Cavity Surface Emitting Laser (VCSEL)-based data links are attractive due to their low-power dissipation and low-cost manufacturability. This chapter reviews the foundations for this technology, as well as the device and module design challenges of extending the data rate beyond the current level. We begin with a review of data communications from the business perspective, and continue with a brief discussion of the current and future standards. This is followed by a survey of recent advances in VCSELs, including data links operating at 28Gb/s. We review the recent efforts on ultra-fast data links and discuss the advantages of the different approaches. We also examine key design aspects of optical transceiver modules and we focus our discussion on novel applications in high-performance computing using both multi-mode and single-mode fiber optics. We highlight the importance of the device/component-level and system-level modeling and show some modeling examples with comparison to measured data. We conclude with a comparison of the VCSEL-based data links with other competing technologies, including silicon photonics and short-cavity edge emitting lasers.

Presentation slides from the 2013 CMOS Emerging Technologies conference in Whistler, Canada

This chapter first reviews the current use of multimode fibers with short-wavelength VCSELS for short-distance applications. Standards are in place for 100Gb/s applications based on 10Gb/s optics and are being developed for ?25Gb/s optics. Light propagation in multimode fibers is briefly discussed to explain the DMD measurement and the metrics developed to qualify OM3 and OM4 fiber, including calculated effective modal bandwidth (EMBc). Bend-insensitive multimode fiber is presented, explaining how the new fiber achieves high bandwidth with low bend loss. New fibers for short-distance consumer applications and home networking are discussed. Finally, fibers designed for high-performance computing (HPC) are reviewed, including multicore fibers for optical interconnects.

This book systematically introduces the single frequency semiconductor laser, which is widely used in many vital advanced technologies, such as the laser cooling of atoms and atomic clock, high-precision measurements and spectroscopy, coherent optical communications, and advanced optical sensors. It presents both the fundamentals and characteristics of semiconductor lasers, including basic F-P structure and monolithic integrated structures; interprets laser noises and their measurements; and explains mechanisms and technologies relating to the main aspects of single frequency lasers, including external cavity lasers, frequency stabilization technologies, frequency sweeping, optical phase locked loops, and so on. It paints a clear, physical picture of related technologies and reviews new developments in the field as well. It will be a useful reference to graduate students, researchers, and engineers in the field.

Photonics in Switching and Computing addresses all aspects of optical interconnected network architectures, optical (sub) systems, optical components and devices, and network management and control plane for telecom, datacom and HPC networks

Photonics in Switching and Computing will highlight the latest research activities in areas related to Photonics in Switching and Computing and will be presented in an environment that is conducive to in depth and open discussions of the trends in this area Research topics include optical switching technologies that allow dense integration of photonic and electronic functionalities operating side by side various aspects of photonics in computing systems optical subsystem technologies and architectures including optical signal processing, integrated advanced modulation schemes optical code translation, label switching and processing and optical networking and computing architectures and systems

Optical interconnection technologies are increasingly deployed in high-performance electronic systems to address challenges in connectivity, size, bandwidth, latency, and cost. Projected performance requirements are leading to formidable cost and energy efficiency challenges. Hybrid and integrated photonic technologies are currently being developed to reduce assembly complexity and to reduce the numbers of individually packaged parts. This chapter provides an overview of the important challenges that photonics currently face, identifies the various optical technologies that are being considered for use at the different interconnection levels, and presents examples of demonstrated state-of-the-art optical interconnection systems. Finally, the prospects and potential of these technologies in the near future are discussed.

Current data centre networks, based on electronic packet switches, are experiencing an exponential increase in network traffic due to developments such as cloud computing. Optical interconnects have emerged as a promising alternative offering high throughput and reduced power consumption. Optical Interconnects for Data Centers reviews key developments in the use of optical interconnects in data centres and the current state of the art in transforming this technology into a reality. The book discusses developments in optical materials and components (such as single and multi-mode waveguides), circuit boards and ways the technology can be deployed in data centres. Optical Interconnects for Data Centers is a key reference text for electronics designers, optical engineers, communications engineers and R&D managers working in the communications and electronics industries as well as postgraduate researchers. Summarizes the state-of-the-art in this emerging field Presents a comprehensive review of all the key aspects of deploying optical interconnects in data centers, from materials and components, to circuit boards and methods for integration Contains contributions that are drawn from leading international experts on the topic

This books focuses on recent break-throughs in the development of a variety of photonic devices, serving distances ranging from mm to many km, together with their electronic counter-parts, e.g. the drivers for lasers, the amplifiers following the detectors and most important, the relevant advanced VLSI circuits. It explains that as a consequence of the increasing dominance of optical interconnects for high performance workstation clusters and supercomputers their complete design has to be revised. This book thus covers for the first time the whole variety of interdependent subjects contributing to green photonics and electronics, serving communication and energy harvesting. Alternative approaches to generate electric power using organic photovoltaic solar cells, inexpensive and again energy efficient in production are summarized. In 2015, the use of the internet consumed 5-6% of the raw electricity production in developed countries. Power consumption increases rapidly and without some transformational change will use, by the middle of the next decade at the latest, the entire electricity production. This apocalyptic outlook led to a redirection of the focus of data center and HPC developers from just increasing bit rates and capacities to energy efficiency. The high speed interconnects are all based on photonic devices. These must and can be energy efficient but they operate in an electronic environment and therefore have to be considered in a wide scope that also requires low energy electronic devices, sophisticated circuit designs and clever architectures. The development of the next generation of high performance exaFLOP computers suffers from the same problem: Their energy consumption based on present device generations is essentially prohibitive.

This book is oriented to be used as a reference guide by young entrepreneurs, investors, VCs, and researchers on VCSEL technologies and its commercial products in daily lives. It consists of a basic introduction to VCSEL technology, the materials and wavelengths involved, its advantages and characteristics, functionality as a data/image transmitter (including receivers), high demand of VCSELs products in Photonics. On the business side, it describes the industry’s landscape on market demands, business models, high volume manufacturing challenges, key players, supply chain, trade control effects, die-cost, providing a few popular examples of commercial products in daily use by customers. The book ends with conclusions regarding the future scope of VCSELs in industrial, medical, smart-home, Si-Photonics & CMOS etc. applications.

Future Directions in Silicon Photonics, Volume 101 in the Semiconductors and Semimetals series, highlights new advances in the field, with this updated volume presenting the latest developments as discussed by esteemed leaders in the field silicon photonics. Provides the authority and expertise of leading contributors from an international board of authors Represents the latest release in the Semiconductors and Semimetals series Includes the latest information on Silicon Photonics

The transmission speed of data communication systems is forecast to increase exponentially over the next decade. Development of both Si-based high-speed drivers as well as III-V-semiconductor-based high-speed vertical cavity surface emitting lasers (VCSELs) are prerequisites for future ultrahigh data-rate systems. This thesis presents: - a survey of the present state of the art of VCSELs - a systematic investigation of the various effects limiting present VCSELs - a catalogue of solutions to overcome present limits - detailed progress in modelling, fabricating and testing the currently most advanced VCSELs at the two commercially most important wavelengths.

Dramatic increases in processing power have rapidly scaled on-chip aggregate bandwidths into the Tb/s range. This necessitates a corresponding increase in the amount of data communicated between chips, so as not to limit overall system performance. To meet the increasing demand for interchip communication bandwidth, researchers are investigating the use of high-speed optical interconnect architectures. Unlike their electrical counterparts, optical interconnects offer high bandwidth and negligible frequency-dependent loss, making possible per-channel data rates of more than 10 Gb/s. High-Speed Photonics Interconnects explores some of the groundbreaking technologies and applications that are based on photonics interconnects. From the Evolution of High-Speed I/O Circuits to the Latest in Photonics Interconnects Packaging and Lasers Featuring contributions by experts from academia and industry, the book brings together in one volume cutting-edge research on various aspects of high-speed photonics interconnects. Contributors delve into a wide range of technologies, from the evolution of high-speed input/output (I/O) circuits to recent trends in photonics interconnects packaging. The book discusses the challenges associated with scaling I/O data rates and current design techniques. It also describes the major high-speed components, channel properties, and performance metrics. The book exposes readers to a myriad of applications enabled by photonics interconnects technology. Learn about Optical Interconnect Technologies Suitable for High-Density Integration with CMOS Chips This richly illustrated work details how optical interchip communication links have the potential to fully leverage increased data rates provided through complementary metal-oxide semiconductor (CMOS) technology scaling at suitable power-efficiency levels. Keeping the mathematics to a minimum, it gives engineers, researchers, graduate students, and entrepreneurs a comprehensive overview of the dynamic landscape of high-speed photonics interconnects.

This book gives a fascinating picture of the state-of-the-art in silicon photonics and a perspective on what can be expected in the near future. It is composed of a selected number of reviews authored by world leaders in the field and is written from both academic and industrial viewpoints. An in-depth discussion of the route towards fully integrated silicon photonics is presented. This book will be useful not only to physicists, chemists, materials scientists, and engineers but also to graduate students who are interested in the fields of microphotonics and

optoelectronics.