

Telecommunication Networks Protocols Modeling And Analysis

Here is the first book to present a unified discussion of protocols that treats both voice and data networks. It emphasizes quantitative performance education of telecommunication network systems. Of interest to electrical engineers and computer science professionals working with networks, data communication and distributed systems.

In network design, the gap between theory and practice is woefully broad. This book narrows it, comprehensively and critically examining current network design models and methods. You will learn where mathematical modeling and algorithmic optimization have been under-utilized. At the opposite extreme, you will learn where they tend to fail to contribute to the twin goals of network efficiency and cost-savings. Most of all, you will learn precisely how to tailor theoretical models to make them as useful as possible in practice. Throughout, the authors focus on the traffic demands encountered in the real world of network design. Their generic approach, however, allows problem formulations and solutions to be applied across the board to virtually any type of backbone communication or computer network. For beginners, this book is an excellent introduction. For seasoned professionals, it provides immediate solutions and a strong foundation for further advances in the use of mathematical modeling for network design. Written by leading researchers with a combined 40 years of industrial and academic network design experience. Considers the development of design models for different technologies, including TCP/IP, IDN, MPLS, ATM, SONET/SDH, and WDM. Discusses recent topics such as shortest path routing and fair bandwidth assignment in IP/MPLS networks. Addresses proper multi-layer modeling across network layers using different technologies—for example, IP over ATM over SONET, IP over WDM, and IDN over SONET. Covers restoration-oriented design methods that allow recovery from failures of large-capacity transport links and transit nodes. Presents, at the end of each chapter, exercises useful to both students and practitioners. "This book presents quality articles focused on key issues concerning the planning, design, maintenance, and management of telecommunications and networking technologies"--Provided by publisher.

Loss networks ensure that sufficient resources are available when a call arrives. However, traditional loss network models for telephone networks cannot cope with today's heterogeneous demands, the central attribute of Asynchronous Transfer Mode (ATM) networks. This requires multiservice loss models. This publication presents mathematical tools for the analysis, optimization and design of multiservice loss networks. These tools are relevant to modern broadband networks, including ATM networks. Addressed are networks with both fixed and alternative routing, and with discrete and continuous bandwidth requirements. Multiservice interconnection networks for switches and contiguous slot assignment for synchronous transfer mode are also presented.

Take an in-depth tour of core Internet protocols and learn how they work together to move data packets from one network to another. With this concise book, you'll delve into the aspects of each protocol, including operation basics and security risks, and learn the function of network hardware such as switches and routers. Ideal for beginning network engineers, each chapter in this book includes a set of review questions, as well as practical, hands-on lab exercises. Understand basic network architecture, and how protocols and functions fit together Learn the structure and operation of the Eth.

Introduction to Computer Networking to Methods for Usability Engineering in Equipment Design.

Substation Automation Systems: Design and Implementation aims to close the gap created by fast changing technologies impacting on a series of legacy principles related to how substation

secondary systems are conceived and implemented. It is intended to help those who have to define and implement SAS, whilst also conforming to the current industry best practice standards. Key features: Project-oriented approach to all practical aspects of SAS design and project development. Uniquely focusses on the rapidly changing control aspect of substation design, using novel communication technologies and IEDs (Intelligent Electronic Devices). Covers the complete chain of SAS components and related equipment instead of purely concentrating on intelligent electronic devices and communication networks. Discusses control and monitoring facilities for auxiliary power systems. Contributes significantly to the understanding of the standard IEC 61850, which is viewed as a "black box" for a significant number of professionals around the world. Explains standard IEC 61850 – Communication networks and systems for power utility automation – to support all new systems networked to perform control, monitoring, automation, metering and protection functions. Written for practical application, this book is a valuable resource for professionals operating within different SAS project stages including the: specification process; contracting process; design and engineering process; integration process; testing process and the operation and maintenance process.

Competition within the telecommunications companies is growing fiercer by the day. Therefore, it is vital to ensure a high level of quality and reliability within all telecommunications systems in order to guard against faults and the failure of components and network services. Within large scale systems such quality and reliability problems are ever higher. The metrics of Quality and Reliability have to date only been available in journals and technical reports of companies which have designed or produced major parts of systems used in large applications. This book provides a self-contained treatment enabling the reader to be able to produce, define and utilise the metrics of Quality and Reliability required for the design and implementation of a large application such as a world class event as the Olympic Games. An additional outcome is that this book can be used as a guide for producing an ISO standard for large scale Systems such as the Olympic Games. * Provides presentations of techniques used for solving quality and reliability problems in telecommunications networks replete with illustrations of their applications to real-world services and world class events * Individual chapters written by respective international experts within their fields This will prove highly informative for Practising engineers, researchers and telecommunications professionals, academics and graduate students in telecommunications, standards bodies and organisations such as ISO. Analysis of Computer and Communication Networks provides the basic techniques for modeling and analyzing two of the fundamental components of high performance networks: switching equipment, and software employed at the end nodes and intermediate switches. The book also reviews the design options used to build efficient switching equipment. Topics covered include Markov chains and queuing analysis, traffic modeling, interconnection networks, and switch architectures and buffering strategies. This book covers the mathematical theory and techniques necessary for analyzing telecommunication systems. Queuing and Markov chain analyses are provided for many protocols currently in use. The book then discusses in detail applications of Markov chains and queuing analysis to model more than 15 communications protocols and hardware components.

The fast growing traffic demand in telecommunication networks, by use of the Internet and an increasing number of broadband services for multimedia communications, requires new high performance networking technologies. As such, optical WDM networks are playing a pivotal role. Wavelength Division Multiplexing (WDM) with many hundreds of wavelength channels per fiber is extensively being exploited in wide area networks. With respect to the ongoing trend towards a completely packet-switched mode of operation for all services, WDM networks must be prepared accordingly. This work concentrates on optical packet-switched networking in local and metro area networks for realizing high-performance applications like virtual reality,

medical imaging, and supercomputing. It is well known that in those networks using a star, bus, or ring shared medium, an access protocol is necessary to guarantee controlled and fair access for all attached nodes. Similar access protocols are to be developed and analyzed for WDM local and metro area networks. Already, many media access protocols for these networks have been described in the literature. However, some aspects of Quality-of-Service (QoS) for different service classes are still an open issue and subject to intensive research activities. In the introduction, the author, Dr. Kemal Bengi, gives a short classification of media access protocols and network architectures for WDM local and metro area networks. The need for service classes is also emphasized.

An authoritative introduction to the roles of switching and transmission in broadband integrated services networks *Principles of Broadband Switching and Networking* explains the design and analysis of switch architectures suitable for broadband integrated services networks, emphasizing packet-switched interconnection networks with distributed routing algorithms. The text examines the mathematical properties of these networks, rather than specific implementation technologies. Although the pedagogical explanations in this book are in the context of switches, many of the fundamental principles are relevant to other communication networks with regular topologies. After explaining the concept of the modern broadband integrated services network and why it is necessary in today's society, the book moves on to basic switch design principles, discussing two types of circuit switch design—space domain and time domain—and packet switch design. Throughput improvements are illustrated by some switch design variations such as Speedup principle, Channel-Grouping principle, Knockout principle, and Dilation principle. Moving seamlessly into advanced switch design principles, the book covers switch scalability, switch design for multicasting, and path switching. Then the focus moves to broadband communications networks that make use of such switches. Readers receive a detailed introduction on how to allocate network resources and control traffic to satisfy the quality of service requirements of network users and to maximize network usage. As an epilogue, the text shows how transmission noise and packet contention have similar characteristics and can be tamed by comparable means to achieve reliable communication. *Principles of Broadband Switching and Networking* is written for senior undergraduate and first-year postgraduate students with a solid background in probability theory.

A class of Delay Tolerant Networks (DTN), which may violate one or more of the assumptions regarding the overall performance characteristics of the underlying links in order to achieve smooth operation, is rapidly growing in importance but may not be well served by the current end-to-end TCP/IP model. *Delay Tolerant Networks: Protocols and Applicat*

The progress of science and technology has placed Queueing Theory among the most popular disciplines in applied mathematics, operations research, and engineering. Although queueing has been on the scientific market since the beginning of this century, it is still rapidly expanding by capturing new areas in technology. *Advances in Queueing* provides a comprehensive overview of problems in this enormous area of science and focuses on the most significant methods recently developed. Written by a team of 24 eminent scientists, the book examines stochastic, analytic, and generic methods such as approximations, estimates and bounds, and simulation. The first chapter presents an overview of classical queueing methods from the birth of queues to the seventies. It also contains the most comprehensive bibliography of books on queueing and telecommunications to date. Each of the following chapters surveys recent methods applied to classes of queueing systems and networks followed by a discussion of open problems and future research directions. *Advances in Queueing* is a practical reference that allows the reader quick access to the latest methods.

This book explores new analytical techniques and tools for the performance evaluation of distributed and integrated computer communication systems. The systems considered are

those arising in LAN, MAN, WAN broadband ISDN, and ATM switching. These systems are mathematically modelled and analysed. Analytical results are presented on the basic queueing models such as multi-queue, priority queue, queueing network, queue with bursty input and superposed input, and multi-server queue. These results can be usefully applied for the performance evaluation of all the above systems.

This book constitutes the refereed proceedings of the 7th IFIP International Conference on Communications and Multimedia Security, CMS 2003, held in Torino, Italy in October 2003. The 21 revised full papers presented were carefully reviewed and selected for presentation. The papers are organized in topical sections on cryptography, network security, mobile and wireless network security, trust and privacy, application security, and multimedia security. Many argue that telecommunications network infrastructure is the most impressive and important technology ever developed. Analyzing the telecom market's constantly evolving trends, research directions, infrastructure, and vital needs, Telecommunication Networks responds with revolutionized engineering strategies to optimize network construction. Omnipresent in society, telecom networks integrate a wide range of technologies. These include quantum field theory for the study of optical amplifiers, software architectures for network control, abstract algebra required to design error correction codes, and network, thermal, and mechanical modeling for equipment platform design. Illustrating how and why network developers make technical decisions, this book takes a practical engineering approach to systematically assess the network as a whole—from transmission to switching. Emphasizing a uniform bibliography and description of standards, it explores existing technical developments and the potential for projected alternative architectural paths, based on current market indicators. The author characterizes new device and equipment advances not just as quality improvements, but as specific responses to particular technical market necessities. Analyzing design problems to identify potential links and commonalities between different parts of the system, the book addresses interdependence of these elements and their individual influence on network evolution. It also considers power consumption and real estate, which sometimes outweigh engineering performance data in determining a product's success. To clarify the potential and limitations of each presented technology and system analysis, the book includes quantitative data inspired by real products and prototypes. Whenever possible, it applies mathematical modeling to present measured data, enabling the reader to apply demonstrated concepts in real-world situations. Covering everything from high-level architectural elements to more basic component physics, its focus is to solve a problem from different perspectives, and bridge descriptions of well-consolidated solutions with newer research trends.

This useful volume adopts a balanced approach between technology and mathematical modeling in computer networks, covering such topics as switching elements and fabrics, Ethernet, and ALOHA design. The discussion includes a variety of queueing models, routing, protocol verification and error codes and divisible load theory, a new modeling technique with applications to grids and parallel and distributed processing. Examples at the end of each chapter provide ample material for practice. This book can serve as a text for an undergraduate or graduate course on computer networks or performance evaluation in electrical and computer engineering or computer science.

Learn all you need to know about wireless sensor networks! Protocols and Architectures for Wireless Sensor Networks provides a thorough description of the nuts and bolts of wireless sensor networks. The authors give an overview of the state-of-the-art, putting all the individual solutions into perspective with one and other. Numerous practical examples, case studies and illustrations demonstrate the theory, techniques and results presented. The clear chapter structure, listing learning objectives, outline and summarizing key points, help guide the reader expertly through the material. Protocols and Architectures for Wireless Sensor Networks:

Covers architecture and communications protocols in detail with practical implementation examples and case studies. Provides an understanding of mutual relationships and dependencies between different protocols and architectural decisions. Offers an in-depth investigation of relevant protocol mechanisms. Shows which protocols are suitable for which tasks within a wireless sensor network and in which circumstances they perform efficiently. Features an extensive website with the bibliography, PowerPoint slides, additional exercises and worked solutions. This text provides academic researchers, graduate students in computer science, computer engineering, and electrical engineering, as well as practitioners in industry and research engineers with an understanding of the specific design challenges and solutions for wireless sensor networks. Check out www.wiley.com/go/wsn for accompanying course material! "I am deeply impressed by the book of Karl & Willig. It is by far the most complete source for wireless sensor networks...The book covers almost all topics related to sensor networks, gives an amazing number of references, and, thus, is the perfect source for students, teachers, and researchers. Throughout the book the reader will find high quality text, figures, formulas, comparisons etc. - all you need for a sound basis to start sensor network research." Prof. Jochen Schiller, Institute of Computer Science, Freie Universität Berlin

With quantum leaps in science and technology occurring at breakneck speed, professionals in virtually every field face a daunting task-practicing their discipline while keeping abreast of new advances and applications in their field. In no field is this more applicable than in the rapidly growing field of telecommunications engineering. Practicing engineers who work with ATM technology on a daily basis must not only keep their skill sharp in areas such as ATM network interfaces, protocols, and standards, but they must also stay informed, about new classes of ATM applications. A Textbook on ATM Telecommunications gives active telecommunications engineers the advantage they need to stay sharp in their field. From the very basics of ATM to state-of-the-art applications, it covers the gamut of topics related to this intriguing switching and multiplexing strategy. Starting with an introduction to telecommunications, this text combines the theory underlying broadband communications technology with applied practical instruction and lessons gleaned from industry. The author covers fundamental communications and network theory, followed by applied ATM networking. Each chapter includes design exercises as well as worked examples. A Textbook on ATM Telecommunications includes examples of design and implementation-making it an ideal tool for both aspiring and practicing telecommunication professionals. Features

As the dividing line between traditional computing science and telecommunications quickly becomes blurred or disappears in today's rapidly changing environment, there is an increasing need for computer professionals to possess knowledge of telecommunications principles. Telecommunications and Networking presents a comprehensive overview of the interaction and relationship between telecommunications and data processing. The book's early chapters cover basic telecommunications vocabulary, common nomenclature, telecommunications fundamentals, as well as the important relationships among coding, error detection and correction, and noise. Later chapters discuss such topics as switching, timing, topological structures, routing algorithms, and teleprocessing. Other topics covered in detail include specific concerns inherent to computer communications, such as protocols, error detection and correction, network monitoring and security, and system validation. System designers and programmers can no longer be effective simply by understanding the tradeoffs between hardware and software. Telecommunications and Networking provides both computing professionals and students the fundamental computer communications concepts necessary to function in today's computer industry.

This book comprises a selection of papers presented at a symposium organized under the aegis of COST Telecommunications Action 285. The main objective of the book is to enhance existing tools and develop new modeling and simulation tools for research in emerging multi-

service telecommunication networks in the areas of model performance improvements, multilayer traffic modeling, and the important issue of evaluation and validation of the new modeling tools.

Publisher Description

"This multiple-volume publications exhibits the most up-to-date collection of research results and recent discoveries in the transfer of knowledge access across the globe"--Provided by publisher.

This book provides an introduction to the software system SMURPH, comprising a programming language, its compiler, and an execution environment, for specifying communication networks and protocols and executing those specifications in virtual worlds mimicking the behavior of real-life implementations. It particularly focuses on SMURPH's wireless modeling capabilities. Written in a manual-like fashion, it includes a comprehensive description of SMURPH functionality, as well as illustrations and case studies to aid understanding.

Mobile users are demanding fast and efficient ubiquitous connectivity supporting data applications. This connectivity has to be provided by various different networks and protocols which guarantee that mobile networks function efficiently, performing routing and handoff for mobile users. Hac proposes a comprehensive design for mobile communications including mobile agents, access networks, application protocols, ubiquitous connectivity, routing, and handoff. It covers the entire spectrum of lower and upper layer protocols to evaluate and design modern mobile telecommunications systems. Furthermore, the aspects of modern mobile telecommunications for applications, networking, and transmission are described. For mobile users and data applications these are new networking and communications solutions, particularly for the local area network environment. * Describes the recent advances in mobile telecommunications, their protocols and management * Covers hot topics such as mobile agents, access networks, wireless applications protocols, wireless LANs, architecture, routing and handoff * Introduces and analyses architecture and design issues in mobile communications and networks * Includes a section of questions/problems/answers after each chapter The book is written as a practical, easily accessible tutorial with many figures and examples of existing protocols and architectures making it essential reading for engineers, system engineers, researchers, managers, senior & graduate students.

A comprehensive discussion of multiple access protocols for cellular systems and the consideration of the specific constraints and capabilities of second and third generation systems regarding the multiple access protocols. Beginning by introducing the cellular concept and discussing second and third generation cellular communication systems, including the evolution from these systems to IP-based systems, the authors then identify the requirements for and problems related to multiple access. In accordance with ETSI and 3GPP standards, a split is made into basic multiple access schemes such as CDMA, TDMA and FDMA and multiple access protocols. The pros and cons of CDMA and TDMA for third generation systems are discussed as well as medium access in GSM, GPRS and UMTS, essentially based on R-ALOHA protocols in all these systems. Data access delay and voice dropping performance is assessed and the different UTRA modes are considered. * Provides an accessible text for individuals with little prior knowledge of cellular communication systems or multiple access protocols * Provides an overview of existing material on cellular communications, multiple access protocols and a combination of the two * Presents extensive research carried out by the authors including extended packet reservation multiple access protocols for TDMA, CDMA and hybrid CDMA/TDMA air interfaces, protocol enhancements and modelling of the physical layer A valuable reference resource for researchers and engineers in the field of cellular communications and packet-based communications, as well as postgraduate and research students in this rapidly evolving field.

This comprehensive handbook brings together experts who use optimization to solve problems that arise in telecommunications. It is the first book to cover in detail the field of optimization in telecommunications. Recent optimization developments that are frequently applied to telecommunications are covered. The spectrum of topics covered includes planning and design of telecommunication networks, routing, network protection, grooming, restoration, wireless communications, network location and assignment problems, Internet protocol, World Wide Web, and stochastic issues in telecommunications. The book's objective is to provide a reference tool for the increasing number of scientists and engineers in telecommunications who depend upon optimization.

The International Teletraffic Congress (ITC) is a recognized international organization taking part in the work of the International Telecommunications Union. The congress traditionally deals with the development of teletraffic theory and its applications to the design, planning and operation of telecommunication systems, networks and services. The contents of ITC 14 illustrate the important role of teletraffic in the current period of rapid evolution of telecommunication networks. A large number of papers address the teletraffic issues behind developments in broadband communications and ATM technology. The extension of possibilities for user mobility and personal communications together with the generalization of common channel signalling and the provision of new intelligent network services are further extremely significant developments whose teletraffic implications are explored in a number of contributions. ITC 14 also addresses traditional teletraffic subjects, proposing enhancements to traffic engineering practices for existing circuit and packet switched telecommunications networks and making valuable original contributions to the fundamental mathematical tools on which teletraffic theory is based. The contents of these Proceedings accurately reflect the extremely wide scope of the ITC, extending from basic mathematical theory to day-to-day traffic engineering practices, and constitute the state of the art in 1994 of one of the fundamental telecommunications sciences.

Learn the core theory and explore real-world networking issues with this richly illustrated example-based textbook. It includes case studies and numerous laboratory exercises that connect theory and practice through hands-on experimentation with real networking devices. Its bottom-up approach is easy for students to follow and perfect for lab-oriented courses. Performance Analysis of Telecommunications and Local Area Networks presents information on teletraffic engineering, with emphasis on modeling techniques, queuing theory, and performance analysis for the public-switched telephone network and computer communication networks. Coverage includes twisted pair cables and coaxial cables, subscriber loops, multistage network switching, modeling techniques for traffic flow and service time, random access networks, and much more. End-of-chapter problems with solutions are also included. Performance Analysis of Telecommunications and Local Area Networks is also a useful reference for practicing engineers but is intended as a textbook in advanced-level courses. Provides a concise overview of stochastic models and mathematical techniques for solving challenging mathematical and statistical problems and enhances readers' overall understanding of communication systems. The book also presents an excellent introduction to a huge area of interesting problems and models arising from modern developments in broadband channel transmission systems.

The research papers in this volume describe recent, original developments in techniques, tools and applications in the area of communication system performance. Involved in the project are researchers from the world's leading universities, research institutes and companies.

The main objective of this workshop was to review and discuss the state of the art and the latest advances in the area of 1-10 Gbit/s throughput for local and metropolitan area networks. The first generation of local area networks had throughputs in the range 1-20 Mbit/s. Well-known examples of this first generation networks are the Ethernet and

the Token Ring. The second generation of networks allowed throughputs in the range 100-200 Mbit/s. Representatives of this generation are the FDDI double ring and the DQDB (IEEE 802.6) networks. The third generation networks will have throughputs in the range 1-10 Gbit/s. The rapid development and deployment of fiber optics worldwide, as well as the projected emergence of a market for broadband services, have given rise to the development of broadband ISDN standards. Currently, the Asynchronous Transfer Mode (ATM) appears to be a viable solution to broadband networks. The possibility of all-optical networks in the future is being examined. This would allow the tapping of approximately 50 terahertz or so available in the lightwave range of the frequency spectrum. It is envisaged that using such a high-speed network it will be feasible to distribute high-quality video to the home, to carry out rapid retrieval of radiological and other scientific images, and to enable multi-media conferencing between various parties.

"This book "quality of service" in organizations, offering fundamental knowledge on the subject, describing the significance of network management and the integration of knowledge to demonstrate how network management is related to QoS in real applications"--Provided by publisher.

This book covers at an advanced level mathematical methods for analysis of telecommunication networks. The book concentrates on various call models used in telecommunications such as quality of service (QoS) in packet-switched Internet Protocol (IP) networks, Asynchronous Transfer Mode (ATM), and Time Division Multiplexing (TDM). Professionals, researchers, and graduate and advanced undergraduate students of telecommunications will benefit from this invaluable guidebook.

This complete guide to setting up and running a TCP/IP network is essential for network administrators, and invaluable for users of home systems that access the Internet. The book starts with the fundamentals -- what protocols do and how they work, how addresses and routing are used to move data through the network, how to set up your network connection -- and then covers, in detail, everything you need to know to exchange information via the Internet. Included are discussions on advanced routing protocols (RIPv2, OSPF, and BGP) and the gated software package that implements them, a tutorial on configuring important network services -- including DNS, Apache, sendmail, Samba, PPP, and DHCP -- as well as expanded chapters on troubleshooting and security. TCP/IP Network Administration is also a command and syntax reference for important packages such as gated, pppd, named, dhcpd, and sendmail. With coverage that includes Linux, Solaris, BSD, and System V TCP/IP implementations, the third edition contains: Overview of TCP/IP Delivering the data Network services Getting started M Basic configuration Configuring the interface Configuring routing Configuring DNS Configuring network servers Configuring sendmail Configuring Apache Network security Troubleshooting Appendices include dip, pppd, and chat reference, a gated reference, a dhcpd reference, and a sendmail reference This new edition includes ways of configuring Samba to provide file and print sharing on networks that integrate Unix and Windows, and a new chapter is dedicated to the important task of configuring the Apache web server. Coverage of network security now includes details on OpenSSH, stunnel, gpg, iptables, and the access control mechanism in xinetd. Plus, the book offers updated information about DNS, including details on BIND 8 and BIND 9, the role

of classless IP addressing and network prefixes, and the changing role of registrars. Without a doubt, TCP/IP Network Administration, 3rd Edition is a must-have for all network administrators and anyone who deals with a network that transmits data over the Internet.

This book constitutes the refereed proceedings of the 17th International Conference on Distributed Computer and Communication Networks, DCCN 2013, held in Moscow, Russia, in October 2013. The 22 revised full papers presented were carefully reviewed and selected from numerous submissions. The papers cover the following subjects: computer and communication networks architecture optimization; control in computer and communication networks; performance and QoS evaluation in wireless networks; modeling and simulation of network protocols; queueing theory; wireless IEEE 802.11, IEEE 802.15, IEEE 802.16 and UMTS (LTE) networks; RFID technology and its application in intellectual transportation networks; protocols design (MAC, Routing) for centimeter and millimeter wave mesh networks; internet and web applications and services; application integration in distributed information systems.

Telecommunications has evolved and grown at an explosive rate in recent years and will undoubtedly continue to do so. As its functions, applications, and technology grow, it becomes increasingly complex and difficult, if not impossible, to meet the demands of a global network using conventional computing technologies. Computational intelligence (CI) is the technology of the future-and the future is now. Computational Intelligence in Telecommunications Networks offers an in-depth look at the rapid progress of CI technology and shows its importance in solving the crucial problems of future telecommunications networks. It covers a broad range of topics, from Call Admission Control, congestion control, and QoS-routing for ATM networks, to network design and management, optical, mobile, and active networks, and Intelligent Mobile Agents. Today's telecommunications professionals need a working knowledge of CI to exploit its potential to overcome emerging challenges. The CI community must become acquainted with those challenges to take advantage of the enormous opportunities the telecommunications field offers. This text meets both those needs, clearly, concisely, and with a depth certain to inspire further theoretical and practical advances.

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