

5g And Beyond Ieee Icc

LPWAN Technologies for IoT and M2M Applications provides insight into LPWAN technologies, also presenting a wide range of applications and a discussion on security issues and future challenges and research directions. This book is a beneficial and insightful resource for university researchers, graduate students and R&D engineers who are designing networks and implementing IoT applications. To support new requirements for this emerging industry, a new paradigm of Low Power Wide Area Networks (LPWAN) has recently evolved, including LoRa, Sigfox and NB-IoT, hence this book presents the latest updates.

A comprehensive and invaluable guide to 5G technology, implementation and practice in one single volume. For all things 5G, this book is a must-read. Signal processing techniques have played the most important role in wireless communications since the second generation of cellular systems. It is anticipated that new techniques employed in 5G wireless networks will not only improve peak service rates significantly, but also enhance capacity, coverage, reliability, low-latency, efficiency, flexibility, compatibility and convergence to meet the increasing demands imposed by applications such as big data, cloud service, machine-to-machine (M2M) and mission-critical communications. This book is a comprehensive and detailed guide to all signal processing techniques employed in 5G wireless networks. Uniquely organized into four categories, New Modulation and Coding, New Spatial Processing, New Spectrum Opportunities and New System-level Enabling Technologies, it covers everything from network architecture, physical-layer (down-link and up-link), protocols and air interface, to cell acquisition, scheduling and rate adaptation, access procedures and relaying to spectrum allocations. All technology aspects and major roadmaps of global 5G standard development and deployments are included in the book. Key Features: Offers step-by-step guidance on bringing 5G technology into practice, by applying algorithms and design methodology to real-time circuit implementation, taking into account rapidly growing applications that have multi-standards and multi-systems. Addresses spatial signal processing for 5G, in particular massive multiple-input multiple-output (massive-MIMO), FD-MIMO and 3D-MIMO along with orbital angular momentum multiplexing, 3D beamforming and diversity. Provides detailed algorithms and implementations, and compares all multicarrier modulation and multiple access schemes that offer superior data transmission performance including FBMC, GFDM, F-OFDM, UFMC, SEFDM, FTN, MUSA, SCMA and NOMA. Demonstrates the translation of signal processing theories into practical solutions for new spectrum opportunities in terms of millimeter wave, full-duplex transmission and license assisted access. Presents well-designed implementation examples, from individual function block to system level for effective and accurate learning. Covers signal processing aspects of emerging system and network architectures, including ultra-dense networks (UDN), software-defined networks (SDN), device-to-device (D2D) communications and cloud radio access network (C-RAN). Inclusive Radio Communication Networks for 5G and Beyond is based on the COST IRACON project that consists of 500 researchers from academia and industry, with 120 institutions from Europe, US and the Far East involved. The book presents state-of-the-art design and analysis methods for 5G (and beyond) radio communication networks, along with key challenges and issues related to the development of 5G networks. Covers the latest research on 5G networks – including propagation, localization, IoT and radio channels Based on the International COST research project, IRACON, with 120 institutions and 500 researchers from Europe, US and the Far East involved Provides coverage of IoT protocols, architectures and applications, along with IoT applications in healthcare Contains a concluding chapter on future trends in mobile communications and networking

Explore foundational and advanced issues in UAV cellular communications with this cutting-edge and timely new resource UAV Communications for 5G and Beyond delivers a comprehensive overview of the potential applications, networking architectures, research findings, enabling technologies, experimental measurement results, and industry standardizations for UAV communications in cellular systems. The book covers both existing LTE infrastructure, as well as future 5G-and-beyond systems. UAV Communications covers a range of topics that will be of interest to students and professionals alike. Issues of UAV detection and identification are discussed, as is the positioning of autonomous aerial vehicles. More fundamental subjects, like the necessary tradeoffs involved in UAV communication are examined in detail. The distinguished editors offer readers an opportunity to improve their ability to plan and design for the near-future, explosive growth in the number of UAVs, as well as the correspondingly demanding systems that come with them. Readers will learn about a wide variety of timely and practical UAV topics, like: Performance measurement for aerial vehicles over cellular networks, particularly with respect to existing LTE performance Inter-cell interference coordination with drones Massive multiple-input and multiple-output (MIMO) for Cellular UAV communications, including beamforming, null-steering, and the performance of forward-link C&C channels 3GPP standardization for cellular-supported UAVs, including UAV traffic requirements, channel modeling, and interference challenges Trajectory optimization for UAV communications Perfect for professional engineers and researchers working in the field of unmanned aerial vehicles, UAV Communications for 5G and Beyond also belongs on the bookshelves of students in masters and PhD programs studying the integration of UAVs into cellular communication systems.

All topics relating to existing and emerging communications networking technologies

Learn about the latest in cognitive and autonomous network management Towards Cognitive Autonomous Networks: Network Management Automation for 5G and Beyond delivers a comprehensive understanding of the current state-of-the-art in cognitive and autonomous network operation. Authors Mwanje and Bell fully describe today's capabilities while explaining the future potential of these powerful technologies. This book advocates for autonomy in new 5G networks, arguing that the virtualization of network functions render autonomy an absolute necessity. Following that, the authors move on to comprehensively explain the background and history of large networks, and how we come to find ourselves in the place we're in now.

Towards Cognitive Autonomous Networks describes several novel techniques and applications of cognition and autonomy required for end-to-end cognition including:

- Configuration of autonomous networks
- Operation of autonomous networks
- Optimization of autonomous networks
- Self-healing autonomous networks

The book concludes with an examination of the extensive challenges facing completely autonomous networks now and in the future.

UAV Communications for 5G and Beyond John Wiley & Sons

This book presents the fundamental concepts, recent advancements, and opportunities for future research in various key enabling technologies in next-generation wireless communications.

The book serves as a comprehensive source of information in all areas of wireless communications with a particular emphasis on physical (PHY) layer techniques related to 5G wireless systems and beyond. In particular, this book focuses on different emerging techniques that can be adopted in 5G wireless networks. Some of those techniques include massive-MIMO, mm-Wave communications, spectrum sharing, device-to-device (D2D) and vehicular to anything (V2X) communications, radio-frequency (RF) based energy harvesting, and NOMA. Subsequent chapters cover the fundamentals and PHY layer design aspects of different techniques that can be useful for the readers to get familiar with the emerging technologies and their applications. This exciting book will explore how Blockchain (BC) technology has the potential to overcome challenges in the current cyber-physical system (CPS) environment. BC is a timestamp ledger of blocks that is used for storing and sharing data in a distributed manner. BC has attracted attention from practitioners and academics in different disciplines, including law, finance, and computer science, due to its use of distributed structure, immutability and security and privacy. However, applying blockchain in a cyber-physical system (CPS) is not straightforward and involves challenges, including lack of scalability, resource consumption, and delay. This book will provide a comprehensive study on blockchain for CPS. CPS and the existing solutions in CPS and will outline the limitations are presented. The key features of blockchain and its salient features which makes it an attractive solution for CPS are discussed. The fundamental challenges in adopting blockchain for CPS including scalability, delay, and resource consumption are presented and described. Blockchain applications in smart grids, smart vehicles, supply chain; and IoT Data marketplaces are explored. The future research directions to further improve blockchain performance in CPS is also provided.

This book gathers high-quality papers presented at the International Conference on Artificial Intelligence and Applications (ICAIA 2020), held at Maharaja Surajmal Institute of Technology, New Delhi, India, on 6–7 February 2020. The book covers areas such as artificial neural networks, fuzzy systems, computational optimization technologies and machine learning.

Offers comprehensive insight into the theory, models, and techniques of ultra-dense networks and applications in 5G and other emerging wireless networks The need for speed—and power—in wireless communications is growing exponentially. Data rates are projected to increase by a factor of ten every five years—and with the emerging Internet of Things (IoT) predicted to wirelessly connect trillions of devices across the globe, future mobile networks (5G) will grind to a halt unless more capacity is created. This book presents new research related to the theory and practice of all aspects of ultra-dense networks, covering recent advances in ultra-dense networks for 5G networks and beyond, including cognitive radio networks, massive multiple-input multiple-output (MIMO), device-to-device (D2D) communications, millimeter-wave communications, and energy harvesting communications. Clear and concise throughout, Ultra-Dense Networks for 5G and Beyond - Modelling, Analysis, and Applications offers a comprehensive coverage on such topics as network optimization; mobility, handoff control, and interference management; and load balancing schemes and energy saving techniques. It delves into the backhaul traffic aspects in ultra-dense networks and studies transceiver hardware impairments and power consumption models in ultra-dense networks. The book also examines new IoT, smart-grid, and smart-city applications, as well as novel modulation, coding, and waveform designs.

One of the first books to focus solely on ultra-dense networks for 5G in a complete presentation Covers advanced architectures, self-organizing protocols, resource allocation, user-base station association, synchronization, and signaling Examines the current state of cell-free massive MIMO, distributed massive MIMO, and heterogeneous small cell architectures Offers network measurements, implementations, and demos Looks at wireless caching techniques, physical layer security, cognitive radio, energy harvesting, and D2D communications in ultra-dense networks Ultra-Dense Networks for 5G and Beyond - Modelling, Analysis, and Applications is an ideal reference for those who want to design high-speed, high-capacity communications in advanced networks, and will appeal to postgraduate students, researchers, and engineers in the field.

The first book on 6G wireless presents an overall vision for 6G - an era of intelligence-of-everything - with drivers, key capabilities, use cases, KPIs, and the technology innovations that will shape it. These innovations include immersive human-centric communication, sensing, localization, and imaging, connected machine learning and networked AI, Industry 4.0 and beyond with connected intelligence, smart cities and life, and the satellite mega-constellation for 3D full-Earth wireless coverage. Also covered are new air-interface and networking technologies, integrated sensing and communications, and integrated terrestrial and non-terrestrial networks. In addition, novel network architectures to enable network AI, user centric networks, native trustworthiness are discussed. Essential reading for researchers in academia and industry working on B5G wireless communications.

This book provides a comprehensive guide to the emerging field of network slicing and its importance to bringing novel 5G applications into fruition. The authors discuss the current trends, novel enabling technologies, and current challenges imposed on the cellular networks. Resource management aspects of network slicing are also discussed by summarizing and comparing traditional game theoretic and optimization based solutions. Finally, the book presents some use cases of network slicing and applications for vertical industries. Topics include 5G deliverables, Radio Access Network (RAN) resources, and Core Network (CN) resources. Discusses the 5G network requirements and the challenges therein and how network slicing offers a solution Features the enabling technologies of future networks and how network slicing will play a role Presents the role of machine learning and data analytics for future cellular networks along with summarizing the machine learning approaches for 5G and beyond networks

This book provides knowledge into the intelligence and security areas of smart-city paradigms. It focuses on connected computing devices, mechanical and digital machines, objects, and/or people that are provided with unique identifiers. The authors discuss the ability to transmit data over a wireless network without requiring human-to-human or human-to-computer interaction via secure/intelligent methods. The authors also provide a strong foundation for researchers to advance further in the assessment domain of these topics in the IoT era. The aim of this book is hence to focus on both the design and implementation aspects of the intelligence and security approaches in smart city applications that are enabled and supported by the IoT paradigms.

Presents research related to cognitive computing and secured telecommunication paradigms; Discusses development of intelligent outdoor monitoring systems via wireless sensing technologies; With contributions from researchers, scientists, engineers and practitioners in telecommunication and smart cities.

Fifth-generation cellular radio access networks are currently being standardized as 5G New Radio (NR). The primary objectives of 5G NR are to provide enhanced mobile broadband (eMBB) and ultra-reliable low latency communication (URLLC) capabilities. This innovative resource analyzes these applications in detail to help readers understand how the flexible design of NR makes it suitable for a wide range of use cases and applications. The rationale behind the design decisions made during the NR standardization process are explored. Readers will be able to

understand the performance limits of NR when applied to non-eMBB scenarios and how NR compares to 4G and IEEE 802.x connectivity solutions for such scenarios. The main features of 5G phase 2 are explored, as well as the use cases that can be addressed by 5G phase 2. The mathematical models are included to help explain the future evolution of NR in Release 16 and beyond. This is the only book that describes both the standards features of NR and the mathematical models/open research issues for 5G, appealing to both industry practitioners and academic researchers.

The rapid growth of the data traffic demands new ways to achieve high-speed wireless links. The backbone networks, data centers, mission-critical applications, as well as end-users sitting in office or home, all require ultra-high throughput and ultra-low latency wireless links. Sophisticated technological advancement and huge bandwidth are required to reduce the latency. Terahertz band, in this regard, has a huge potential to provide these high-capacity links where a user can download the file in a few seconds. To realize the high-capacity wireless links for future applications, in this book, different aspects of the Terahertz band wireless communication network are presented. This book highlights the Terahertz channel characteristics and modeling, antenna design and beamforming, device characterization, applications, and protocols. It also provides state-of-the-art knowledge on different communication aspects of Terahertz communication and techniques to realize the true potential of the Terahertz band for wireless communication.

Backscattering and RF Sensing for Future Wireless Communication Discover what lies ahead in wireless communication networks with this insightful and forward-thinking book written by experts in the field Backscattering and RF Sensing for Future Wireless Communication delivers a concise and insightful picture of emerging and future trends in increasing the efficiency and performance of wireless communication networks. The book shows how the immense challenge of frequency saturation could be met via the deployment of intelligent planar electromagnetic structures. It provides an in-depth coverage of the fundamental physics behind these structures and assesses the enhancement of the performance of a communication network in challenging environments, like densely populated urban centers. The distinguished editors have included resources from a variety of leading voices in the field who discuss topics such as the engineering of metasurfaces at a large scale, the electromagnetic analysis of planar metasurfaces, and low-cost and reliable backscatter communication. All of the included works focus on the facilitation of the development of intelligent systems designed to enhance communication network performance. Readers will also benefit from the inclusion of: A thorough introduction to the evolution of wireless communication networks over the last thirty years, including the imminent saturation of the frequency spectrum An exploration of state-of-the-art techniques that next-generation wireless networks will likely incorporate, including software-controlled frameworks involving artificial intelligence An examination of the scattering of electromagnetic waves by metasurfaces, including how wave propagation differs from traditional bulk materials A treatment of the evolution of artificial intelligence in wireless communications Perfect for researchers in wireless communications, electromagnetics, and urban planning, Backscattering and RF Sensing for Future Wireless Communication will also earn a place in the libraries of government policy makers, technologists, and telecom industry stakeholders who wish to get a head start on understanding the technologies that will enable tomorrow's wireless communications.

This book provides a common framework for mobility management that considers the theoretical and practical aspects of systems optimization for mobile networks. In this book, the authors show how an optimized system of mobility management can improve the quality of service in existing forms of mobile communication. Furthermore, they provide a theoretical approach to mobility management, as well as developing the model for systems optimization, including practical case studies using network layer and mobility layer protocols in different deployment scenarios. The authors also address the different ways in which the specific mobility protocol can be developed, taking into account numerous factors including security, configuration, authentication, quality of service, and movement patterns of the mobiles. Key Features: Defines and discusses a common set of optimization methodologies and their application to all mobility protocols for both IPv4 and IPv6 networks Applies these technologies in the context of various layers: MAC layer, network layer, transport layer and application layer covering 802.11, LTE, WiMax, CDMA networks and protocols such as SIP, MIP, HIP, VoIP, and many more Provides a thorough analysis of the required steps during a mobility event such as discovery, network selection, configuration, authentication, security association, encryption, binding update, and media direction Includes models and tables illustrating the analysis of mobility management as well as architecture of sample wireless and mobility test beds built by the authors, involving inter-domain and intra-domain mobility scenarios This book is an excellent resource for professionals and systems architects in charge of designing wireless networks for commercial (3G/4G), LTE, IMS, military and Ad Hoc environment. It will be useful deployment guide for the architects wireless service providers. Graduate students, researchers in industry and academia, and systems engineers will also find this book of interest.

This book covers basic principles of telecommunications and their applications in the design and analysis of modern networks and systems. Aimed to make telecommunications engineering easily accessible to students, this book contains numerous worked examples, case studies and review questions at the end of each section. Readers of the book can thus easily check their understanding of the topics progressively. To render the book more hands-on, MATLAB® software package is used to explain some of the concepts. Parts of this book are taught in undergraduate curriculum, while the rest is taught in graduate courses. Telecommunications Engineering: Theory and Practice treats both traditional and modern topics, such as blockchain, OFDM, OFDMA, SC-FDMA, LPDC codes, arithmetic coding, polar codes and non-orthogonal multiple access (NOMA).

This book discusses the smooth integration of optical and RF networks in 5G and beyond (5G+) heterogeneous networks (HetNets), covering both planning and operational aspects. The integration of high-frequency air interfaces into 5G+ wireless networks can relieve the congested radio frequency (RF) bands. Visible light communication (VLC) is now emerging as a promising candidate for future generations of HetNets. Heterogeneous RF-optical networks combine the high throughput of visible light and the high reliability of RF. However, when implementing these HetNets in mobile scenarios, several challenges arise from both planning and operational perspectives. Since the mmWave, terahertz, and visible light bands share similar wave propagation characteristics, the concepts presented here can be broadly applied in all such bands. To facilitate the planning of RF-optical HetNets, the authors present an algorithm that specifies the joint optimal densities of the base stations by drawing on stochastic geometry in order to satisfy the users' quality-of-service (QoS) demands with minimum network power consumption. From an operational perspective, the book explores vertical handovers and multi-homing using a cooperative framework. For vertical handovers, it employs a data-driven approach based on deep neural networks to predict abrupt optical outages; and, on the basis of this prediction, proposes a reinforcement learning strategy that ensures minimal network

latency during handovers. In terms of multi-homing support, the authors examine the aggregation of the resources from both optical and RF networks, adopting a two-timescale multi-agent reinforcement learning strategy for optimal power allocation. Presenting comprehensive planning and operational strategies, the book allows readers to gain an in-depth grasp of how to integrate future coexisting networks at high-frequency bands in a cooperative manner, yielding reliable and high-speed 5G+ HetNets.

Networks, communications, and computing have become ubiquitous and inseparable parts of everyday life. This book is based on a Special Issue of the Algorithms journal, and it is devoted to the exploration of the many-faceted relationship of networks, communications, and computing. The included papers explore the current state-of-the-art research in these areas, with a particular interest in the interactions among the fields.

Learn how radio access network (RAN) slicing allows 5G networks to adapt to a wide range of environments in this masterful resource Radio Access Network Slicing and Virtualization for 5G Vertical Industries provides readers with a comprehensive and authoritative examination of crucial topics in the field of radio access network (RAN) slicing. Learn from renowned experts as they detail how this technology supports and applies to various industrial sectors, including manufacturing, entertainment, public safety, public transport, healthcare, financial services, automotive, and energy utilities. Radio Access Network Slicing and Virtualization for 5G Vertical Industries explains how future wireless communication systems must be built to handle high degrees of heterogeneity, including different types of applications, device classes, physical environments, mobility levels, and carrier frequencies. The authors describe how RAN slicing can be utilized to adapt 5G technologies to such wide-ranging circumstances. The book covers a wide range of topics necessary to understand RAN slicing, including: Physical waveforms design Multiple service signals coexistence RAN slicing and virtualization Applications to 5G vertical industries in a variety of environments This book is perfect for telecom engineers and industry actors who wish to identify realistic and cost-effective concepts to support specific 5G verticals. It also belongs on the bookshelves of researchers, professors, doctoral, and postgraduate students who want to identify open issues and conduct further research. A comprehensive overview of the 5G landscape covering technology options, most likely use cases and potential system architectures.

Discover how the Internet of Things will change the information and communication technology industry in the next decade The Intelligent Internet of Things explores a unique type of Internet of Things (IoT) architecture, for example, the Web of Things (WoT) with its open character that breaks the barriers among various IoT vertical applications. The authors—noted experts on the topic—examine and compare key technologies from physical to platform level, especially the Narrow Band Internet of Things (NB-IoT) technology. They discuss applications with different data transmission requirements that are typical to IoT. The text also describes the requirements of WoT applications on 5G and includes detailed information on WoT technologies. The Intelligent Internet of Things examines three typical WoT applications: the monitoring application of south-to-north water diversion projects; smart driving applications; and network optimization applications. In addition, the text explores testing and authentication of IoT key technologies, with the required equipment, platform, and outdoor environment development. This important book: Provides information on what IoT/WoT is, when to use it, how to provide IoT services with certain technologies, and more Discusses restful architecture, main protocols (ZigBee, 6lowpan, CoAP, HTML5) Explores key technologies on different layers (sensing, gathering, application) Examines how IoT will change the information and communication technology industry Written for professionals working in IoT development, management and big data analytics, Intelligent Internet of Things offers an overview of IoT architecture, key technology, current applications and future development of the technology.

To advantageously plan and design for the explosive near-future increase in the number of unmanned aerial vehicles (UAVs) and their demanding applications, integration of UAVs into cellular communication systems has seen increasing interest. This book provides a timely and comprehensive overview of the recent research efforts and results of unmanned aerial vehicles (UAVs)-integrated cellular network communications. The aim of the book is to provide a comprehensive coverage of the potential applications, networking architectures, latest research findings and key enabling technologies, experimental measurement results, as well as up-to-date industry standardizations for UAV communications in cellular systems, including the existing LTE as well as the future 5G-and-beyond systems.

This book discusses how to plan the time-variant placements of the UAVs served as base station (BS)/relay, which is very challenging due to the complicated 3D propagation environments, as well as many other practical constraints such as power and flying speed. Spectrum sharing with existing cellular networks is also investigated in this book. The emerging unmanned aerial vehicles (UAVs) have been playing an increasing role in the military, public, and civil applications. To seamlessly integrate UAVs into future cellular networks, this book will cover two main scenarios of UAV applications as follows. The first type of applications can be referred to as UAV Assisted Cellular Communications. Second type of application is to exploit UAVs for sensing purposes, such as smart agriculture, security monitoring, and traffic surveillance. Due to the limited computation capability of UAVs, the real-time sensory data needs to be transmitted to the BS for real-time data processing. The cellular networks are necessarily committed to support the data transmission for UAVs, which the authors refer to as Cellular assisted UAV Sensing. To support real-time sensing streaming, the authors design joint sensing and communication protocols, develop novel beamforming and estimation algorithms, and study efficient distributed resource optimization methods. This book targets signal processing engineers, computer and information scientists, applied mathematicians and statisticians, as well as systems engineers to carve out the role that analytical and experimental engineering has to play in UAV research and development. Undergraduate students, industry managers, government research agency workers and general readers interested in the fields of communications and networks will also want to read this book.

Tactile Internet: with Human-in-the-Loop describes the change from the current Internet, which focuses on the democratization of information independent of location of time, to

the Tactile Internet, which democratizes skills to promote equity that is independent of age, gender, socio-cultural background or physical limitations. The book introduces and promotes the concept of the tactile Tactile Internet for remote closed-loop human-machine interaction and describes the main challenges and key technologies. Current standardization activities in the field for IEEE and IETF are described, making this text book an ideal resource for researchers, graduate students, and industry R&D engineers in communications engineering, electronic engineering computing, and computer engineering. Provides a comprehensive reference that addresses all aspects of the Tactile Internet – technologies, engineering challenges, use cases and standards Written by leading researchers in the field Presents current standardizations surrounding the IETF and the IEEE Contains use cases that illustrate practical applications

This book presents comprehensive coverage of current and emerging multiple access, random access, and waveform design techniques for 5G wireless networks and beyond. A definitive reference for researchers in these fields, the book describes recent research from academia, industry, and standardization bodies. The book is an all-encompassing treatment of these areas addressing orthogonal multiple access and waveform design, non-orthogonal multiple access (NOMA) via power, code, and other domains, and orthogonal, non-orthogonal, and grant-free random access. The book builds its foundations on state of the art research papers, measurements, and experimental results from a variety of sources.

This book gathers selected papers presented at the Inventive Communication and Computational Technologies conference (ICICCT 2019), held on 29–30 April 2019 at Gnanamani College of Technology, Tamil Nadu, India. The respective contributions highlight recent research efforts and advances in a new paradigm called ISMAC (IoT in Social, Mobile, Analytics and Cloud contexts). Topics covered include the Internet of Things, Social Networks, Mobile Communications, Big Data Analytics, Bio-inspired Computing and Cloud Computing. The book is chiefly intended for academics and practitioners working to resolve practical issues in this area.

A comprehensive study in efficient multi-rate teletraffic loss models used for designing, performance analysis, and optimization of systems and networks Efficient Multirate Teletraffic Loss Models Beyond Erlang is an easy-to-read book filled with numerous efficient teletraffic loss models. Presented in three sections—Teletraffic Models of Random Input, Teletraffic Models of Quasi-Random Input, and Teletraffic Models of Batched Poisson Input—it covers everything that a professional experienced with optimization and dimensioning of telecom networks could ever need to know. This unique book provides a detailed explanation on how efficient multirate teletraffic loss models are extracted and applied, and guides readers through almost all network technologies and services. Starting from the basics, it steadily increases in difficulty to keep the book self-contained and to provide a better understanding to those who might be new to the subject. It includes detailed explanations of the complex teletraffic models—many of which were developed by the authors. Tutorial examples, several backed by supplementary software, are accompanied by intermediate results and figures. Additionally, end-of-chapter applications describe the applicability of the models to modern network technologies, updating the incorporated teletraffic models of commercial packages/tools. Uses the classic EMLM (Erlang Multirate Loss Model) as its base to present a comprehensive range of teletraffic models through detailed explanation and numerical examples Filled with the authors' own original teletraffic models—making for a wholly unique learning experience Offers a clear, self-contained presentation with a beginning, middle, and end Starts with simple models, then moves to more complex models, before finishing with complicated ones Supplemented by an accompanying website with computer implementation of the most important models Directed primarily at telecommunication engineers, Efficient Multirate Teletraffic Loss Models Beyond Erlang is also useful for telecom operators or managers on the higher and average levels, as well a Ph.D. students, researchers, and modelers.

This book provides a tutorial on quantum communication networks. The authors discuss current paradigm shifts in communication networks that are needed to add computing and storage to the simple transport ideas of prevailing networks. They show how these 'softwarized' solutions break new grounds to reduce latency and increase resilience. The authors discuss how even though these solutions have inherent problems due to introduced computing latency and energy consumption, the problems can be solved by hybrid classical-quantum communication networks. The book brings together quantum networking, quantum information theory, quantum computing, and quantum simulation.

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