Baseband Unit Bbu Baseband Unit Definition

With optical fiber telecommunications firmly entrenched in the global information infrastructure, a key question for the future is how deeply will optical communications penetrate and complement other forms of communication (e.g., wireless access, on-premises networks, interconnects, and satellites). Optical Fiber Telecommunications, the seventh edition of the classic series that has chronicled the progress in the research and development of lightwave communications since 1979, examines present and future opportunities by presenting the latest advances on key topics such as: Fiber and 5G-wireless access networks Inter- and intra-data center communications Free-space and quantum communication links Another key issue is the use of advanced photonics manufacturing and electronic signal processing to lower the cost of services and increase the system performance. To address this, the book covers: Foundry and software capabilities for widespread user access to photonic integrated circuits Nano- and microphotonic components Advanced and nonconventional data modulation formats The traditional emphasis of achieving higher data rates and longer transmission distances are also addressed through chapters on space-division-multiplexing, undersea cable systems, and efficient reconfigurable networking. This book is intended as an ideal reference suitable for university and industry researchers, graduate students, optical systems implementers, network operators, managers, and investors. Quotes: "This book series, which owes much of its distinguished history to the late Drs. Kaminow and Li, describes hot and growing applied topics, which include long-distance and wideband systems, data centers, 5G, wireless networks, foundry production of photonic integrated circuits, quantum communications, and AI/deep-learning. These subjects will be highly beneficial for industrial R&D engineers, university teachers and students, and funding agents in the business sector." Prof. Kenichi Iga President (Retired), Tokyo Institute of Technology "With the passing of two luminaries, Ivan Kaminow and Tingye Li, I feared the loss of one of the premier reference books in the field. Happily, this new version comes to chronicle the current state-of-the-art and is written by the next generation of leaders. This is a must-have reference book for anyone working in or trying to understand the field of optical fiber communications technology." Dr. Donald B. Keck Vice President, Corning, Inc. (Retired) "This book is the seventh edition in the definitive series that was previously marshaled by the extraordinary Ivan Kaminow and Tingye Li, both sadly no longer with us. The series has charted the remarkable progress made in the field, and over a billion kilometers of optical fiber currently snake across the globe carrying ever-increasing Internet traffic. Anyone wondering about how we will cope with this incredible growth must read this book." Prof. Sir David Payne Director, Optoelectronics Research Centre, University of Southampton 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

The People and Ideas 2018 captures all the top influential people and the most important Ideas and trending articles of 2017 in social, economic and political fields. This ebook has been designed to cater to aspirants of various competitive exams like Civil services, Banks, Railways, UPSC and PSC exams and Quiz Competition across the country. The ebook will also be useful for GD, Interviews etc. Table of Contents People 2017 Ideas 2017

Cloud computing has provided multiple advantages as well as challenges to software and infrastructure services. In order to be fully beneficial, these challenges facing cloud specific communication protocols must be addressed. Communication Infrastructures for Cloud Computing presents the issues and research directions for a broad range of cloud computing aspects of software, computing, and storage systems. This book will highlight a broad range of topics in communication infrastructures for cloud computing that will benefit researchers, academics, and practitioners in the active fields of engineering, computer science, and software.

This book investigates new enabling technologies for Fi-Wi convergence. The editors discuss Fi-Wi technologies at the three major network levels involved in the path towards convergence: system level, network architecture level, and network management level. The main topics will be: a. At system level: Radio over Fiber (digitalized vs. analogic, standardization, E-band and beyond) and 5G wireless technologies; b. Network architecture level: NGPON, WDM-PON, BBU Hotelling, Cloud Radio Access Networks (C-RANs), HetNets. c. Network management level: SDN for convergence, Next-generation Point-of-Presence, Wi-Fi LTE Handover, Cooperative MultiPoint.

Learn to design, implement, and secure your IoT infrastructure. Revised and expanded for edge computing. Key Features Build a complete IoT system that's the best fit for your organization Learn about different concepts, tech, and trade-offs in the IoT architectural stack Understand the theory and implementation of each element that comprises IoT design Book Description Industries are embracing IoT technologies to improve operational expenses, product life, and people's well-being. An architectural guide is needed if you want to traverse the spectrum of technologies needed to build a successful IoT system, whether that's a single device or millions of IoT devices. IoT and Edge Computing for Architects, Second Edition encompasses the entire spectrum of IoT solutions, from IoT sensors to the cloud. It examines modern sensor systems, focusing on their power and functionality. It also looks at communication theory, paying close attention to near-range PAN, including the new Bluetooth® 5.0 specification and mesh networks. Then, the book explores IP-based communication in LAN and WAN, including 802.11ah, 5G LTE cellular, Sigfox, and LoRaWAN. It also explains edge computing, routing and gateways, and their role in fog computing, as well as the messaging protocols of MQTT 5.0 and CoAP. With the data now in internet form, you'll get an understanding of cloud and fog architectures, including the OpenFog standards. The book wraps up the analytics portion with the application of statistical analysis, complex event processing, and deep learning models. The book then concludes by providing a holistic view of IoT security, cryptography, and shell security in addition to software-defined perimeters and blockchains. What you will learn Understand the role and scope of architecting a successful IoT deployment Scan the landscape of IoT technologies, from sensors to the cloud and more See the trade-offs in choices of protocols and communications in IoT deployments Become familiar with the terminology needed to work in the IoT space Broaden your skills in the multiple engineering domains necessary for the IoT architect Implement best practices to ensure reliability, scalability, and security in your IoT infrastructure Who this book is for This book is for architects, system designers, technologists, and technology managers who want to understand the IoT ecosphere, technologies, and trade-offs, and develop a 50,000-foot view of IoT architecture. An understanding of the architectural side of IoT is necessary.

Shaping Future 6G Networks Discover the societal and technology drivers contributing to build the next generation of wireless telecommunication networks Shaping Future 6G Networks: Needs, Impacts, and Technologies is a holistic snapshot on the evolution of 5G technologies towards 6G. With contributions from international key players in industry and academia, the book presents the hype versus the realistic capabilities of 6G technologies, and delivers cutting-edge business and technological insights into the future wireless telecommunications landscape. You'll learn about: Forthcoming demand for post 5G networks, including new requirements coming from small and large businesses, manufacturing, logistics, and automotive industry Societal implications of 6G, including digital sustainability, strategies for increasing energy efficiency, as well as future open networking ecosystems Impacts of integrating non-terrestrial networks to build the 6G architecture Opportunities for emerging THz radio access technologies in future integrated communications, positioning, and sensing capabilities in 6G Design of highly modular and distributed 6G core networks driven by the ongoing RAN-Core integration and the benefits of AI/ML-based control and management Disruptive architectural considerations influenced by the Post-Shannon Theory The insights in Shaping Future 6G Networks will greatly benefit IT engineers and managers focused on the future of networking, as well as undergraduate and graduate engineering students focusing on the design, implementation, and management of mobile networks and applications.

This book examines the extensive changes in markets, technologies and value chains that telecommunication companies are currently

confronted with. It analyzes the crossroads they have reached and the choices that now need to be made – to be a bit pipe or a trendsetter of digitalization. Based on an analysis of the key challenges for telcos, the book derives future market scenarios and puts forward recommendations for how they can successfully position themselves. It proposes a framework based on seven "levers," which addresses concrete measures in each step of the value chain, ranging from technology, IT and processes, to innovation, marketing and sales issues. The book discusses the current challenges and provides both general recommendations and concrete solutions. Respected experts illustrate innovative strategic and technical trends and provide insights gained in real-life transformation projects. Recent developments in the areas of regulation, product development, competition between over-the-top (OTT) providers and telcos, as well as technical innovations like 5G, SDN/NFV, LEO satellites and MEC are discussed. Accordingly, practitioners, managers and researchers alike will benefit from the book's wealth of examples and up-to-date insights.

This book provides a comprehensive view of green communicationsconsidering all areas of ICT including wireless and wirednetworks. It analyses particular concepts and practices,addressing holistic approaches in future networks considering asystem perspective. It makes full use of tables,illustrations, performance graphs, case studies and examplesmaking it accessible for a wide audience.

An Introduction to 5G Wireless Networks book is for students, engineers, managers and for marketing/sales executives, to develop a good understanding of the 5G technology. This book covers the 5G architecture, 5G New Radio (NR), 5G Next Generation Core (NG-Core), Network Slicing, Virtualization of 5G Components, Multi-access Edge Computing (MEC) and the various 5G use cases. This book provides details on the evolution of the wireless networks from 1G to 5G, status of 5G deployments and the 5G marketplace (standard bodies, open source communities and vendors). After reading this book, you will be able to have discussions with customers, interviewers and other stakeholders on the 5G concepts, ecosystem and use-cases.

This book written for students of electronics and communication, students of computer science and communications engineers addresses topics such as Introduction of CRN, Advanced spectrum sensing techniques, Cooperative sensing techniques, Distributed sensing techniques, Issues in advanced sensing techniques, and Applications of 5G Networks. It provides new algorithms, explores recent results, and evaluates the performance of technologies in use in this area. It also provides new research topics and sensing techniques related to 5G networks for researchers.

About the Book Recent industry surveys expect the cloud computing services market to be in excess of $20 billion and cloud computing jobs to be in excess of 10 million worldwide in 2014 alone. In addition, since a majority of existing information technology (IT) jobs is focused on maintaining legacy in-house systems, the demand for these kinds of jobs is likely to drop rapidly if cloud computing continues to take hold of the industry. However, there are very few educational options available in the area of cloud computing beyond vendor-specific training by cloud providers themselves. Cloud computing courses have not found their way (yet) into mainstream college curricula. This book is written as a textbook on cloud computing for educational programs at colleges. It can also be used by cloud service providers who may be interested in offering a broader perspective of cloud computing to accompany their own customer and employee training programs. The typical reader is expected to have completed a couple of courses in programming using traditional high-level languages at the college-level, and is either a senior or a beginning graduate student in one of the science, technology, engineering or mathematics (STEM) fields. We have tried to write a comprehensive book that transfers knowledge through an immersive "hands-on approach", where the reader is provided the necessary guidance and knowledge to develop working code for real-world cloud applications. Additional support is available at the book's website: www.cloudcomputingbook.info Organization The book is organized into three main parts. Part I covers technologies that form the foundations of cloud computing. These include topics such as virtualization, load balancing, scalability & elasticity, deployment, and replication. Part II introduces the reader to the design & programming aspects of cloud computing. Case studies on design and implementation of several cloud applications in the areas such as image processing, live streaming and social networks analytics are provided. Part III introduces the reader to specialized aspects of cloud computing including cloud application benchmarking, cloud security, multimedia applications and big data analytics. Case studies in areas such as IT, healthcare, transportation, networking and education are provided.

Fog Radio Access Network (F-RAN) has been shown to be a promising network architecture for the 5G network. With F-RAN, certain amount of signal processing functionalities are pushed from the Base Station (BS) on the network edge to the BaseBand Units (BBU) pool located remotely in the cloud. Hence, partially centralized network operation and management can be achieved, which can greatly improve the energy and spectral efficiency of the network, in order to meet the requirements of 5G. In this work, the optimal design for both uplink and downlink of F-RAN are intensively investigated.eng

This unique text will enable readers to understand the fundamental theory, current techniques, and potential applications of Cloud Radio Access Networks (C-RANs). Leading experts from academia and industry provide a guide to all of the key elements of C-RANs, including system architecture, performance analysis, technologies in both physical and medium access control layers, self-organizing and green networking, standards development, and standardization perspectives. Recent developments in the field are covered, as well as open research challenges and possible future directions. The first book to focus exclusively on Cloud Radio Access Networks, this is essential reading for engineers in academia and industry working on future wireless networks.

The fifth generation of mobile communication systems (5G) is nowadays a reality. 5G networks are been deployed all over the world, and the first 5G-capable devices (e.g., smartphones, tablets, wearable, etc.) are already commercially available. 5G systems provide unprecedented levels of connectivity and quality of service (QoS) to cope with the incessant growth in the number of connected devices and the huge increase in data-rate demand. Massive MIMO (multiple-input multiple-output) technology plays a key role in 5G systems. The underlying principle of this technology is the use of a large number of co-located antennas at the base station, which coherently transmit/receive signals to/from multiple users. This signal co-processing at multiple antennas leads to manifold benefits: array gain, spatial diversity and spatial user multiplexing. These elements enable to meet the QoS requirements established for the 5G systems. The major bottleneck of massive MIMO systems as well as of any cellular network is the inter-cell interference, which affects significantly the cell-edge users, whose performance is already degraded by the path attenuation. To overcome these limitations and provide uniformly excellent service to all the users we need a more radical approach: we need to challenge the cellular paradigm. In this regard, cell-free massive MIMO constitutes the paradigm shift. In the cell-free paradigm, it is not the base station surrounded by the users, but rather it is each user being surrounded by smaller, simpler, serving base stations referred to as access points (APs). In such a system, each user experiences being in the cell-center, and it does not experience any cell boundaries. Hence, the terminology cell-free. As a result, users are not affected by inter-cell interference, and the path attenuation is significantly reduced due to the presence of many APs in their proximity. This leads to

impressive performance. Although appealing from the performance viewpoint, the designing and implementation of such a distributed massive MIMO system is a challenging task, and it is the object of this thesis. More specifically, in this thesis we study: Paper A) The large potential of this promising technology in realistic indoor/outdoor scenarios while also addressing practical deployment issues, such as clock synchronization among APs, and cost-efficient implementations. We provide an extensive description of a cell-free massive MIMO system, emphasizing strengths and weaknesses, and pointing out differences and similarities with existing distributed multiple antenna systems, such as Coordinated MultiPoint (CoMP). Paper B) How to preserve the scalability of the system, by proposing a solution related to data processing, network topology and power control. We consider a realistic scenario where multiple central processing units serve disjoint subsets of APs, and compare the spectral efficiency provided by the proposed scalable framework with the canonical cell-free massive MIMO and CoMP. Paper C) How to improve the spectral efficiency (SE) in the downlink (DL), by devising two distributed precoding schemes, referred to as local partial zero-forcing (ZF) and local protective partial ZF, that provide an adaptable trade-off between interference cancelation and boosting of the desired signal, with no additional front-haul overhead, and that are implementable by APs with very few antennas. We derive closed-form expressions for the achievable SE under the assumption of independent Rayleigh fading channel, channel estimation error and pilot contamination. These closed-form expressions are then used to devise optimal max-min fairness power control. Paper D) How to further improve the SE by letting the user estimate the DL channel from DL pilots, instead of relying solely on the knowledge of the channel statistics. We derive an approximate closed-form expression of the DL SE for conjugate beamforming (CB), and assuming independent Rayleigh fading. This expression accounts for beamformed DL pilots, estimation errors and pilot contamination at both the AP and the user side. We devise a sequential convex approximation algorithm to globally solve the max-min fairness power control optimization problem, and a greedy algorithm for uplink (UL) and DL pilot assignment. The latter consists in jointly selecting the UL and DL pilot pair, for each user, that maximizes the smallest SE in the network. Paper E) A precoding scheme that is more suitable when only the channel statistics are available at the users, referred to as enhanced normalized CB. It consists in normalizing the precoding vector by its squared norm in order to reduce the fluctuations of the effective channel seen at the user, and thereby to boost the channel hardening. The performance achieved by this scheme is compared with the CB scheme with DL training (described in Paper D). Paper F) A maximum-likelihood-based method to estimate the channel statistics in the UL, along with an accompanying pilot transmission scheme, that is particularly useful in line-of-sight operation and in scenarios with resource constraints. Pilots are structurally phase-rotated over different coherence blocks to create an effective statistical distribution of the received pilot signal that can be efficiently exploited by the AP when performing the proposed estimation method. The overall conclusion is that cell-free massive MIMO is not a utopia, and a practical, distributed, scalable, high-performance system can be implemented. Today it represents a hot research topic, but tomorrow it might represent a key enabler for beyond-5G technology, as massive MIMO has been for 5G. La quinta generazione dei sistemi radiomobili cellulari (5G) è oggi una realtà. Le reti 5G si stanno diffondendo in tutto il mondo e i dispositivi 5G (ad esempio smartphones, tablets, indossabili, ecc.) sono già disponibili sul mercato. I sistemi 5G garantiscono livelli di connettività e di qualità di servizio senza precedenti, per fronteggiare l'incessante crescita del numero di dispositivi connessi alla rete e della domanda di dati ad alta velocità. La tecnologia Massive MIMO (multiple-input multiple-output) riveste un ruolo fondamentale nei sistemi 5G. Il principio alla base di questa tecnologia è l'impiego di un elevato numero di antenne collocate nella base station (stazione radio base) le quali trasmettono/ricevono segnali, in maniere coerenti, a/da più terminali utente. Questo co-processamento del segnale da parte di più antenne apporta molteplici benefici: guadagno di array, diversità spaziale e multiplazione degli utenti nel dominio spaziale. Questi elementi consentono di raggiungere i requisiti di servizio stabiliti per i sistemi 5G. Tuttavia, il limite principale dei sistemi massive MIMO, così come di ogni rete cellulare, è rappresentato dalla interferenza inter-cella (ovvero l'interferenza tra aree di copertura gestite da diverse base stations), la quale riduce in modo significativo le performance degli utenti a bordo cella, già degradate dalle attenuazioni del segnale dovute alla considerevole distanza dalla base station. Per superare queste limitazioni e fornire una qualità del servizio uniformemente eccellente a tutti gli utenti, è necessario un approccio più radicale e guardare oltre il classico paradigma cellulare che caratterizza le attuali architetture di rete. A tal proposito, cell-free massive MIMO (massive MIMO senza celle) costituisce un cambio di paradigma: ogni utente è circondato e servito contemporaneamente da numerose, semplici e di dimensioni ridotte base stations, denominate access points (punti di accesso alla rete). Gli access points cooperano per servire tutti gli utenti nella loro area di copertura congiunta, eliminando l'interferenza inter-cella e il concetto stesso di cella. Non risentendo più dell'effetto "bordo-cella", gli utenti possono usufruire di qualità di servizio e velocità dati eccellenti. Sebbene attraente dal punto di vista delle performance, l'implementazione di un tale sistema distribuito è una operazione impegnativa ed è oggetto di questa tesi. Piu specificatamente, questa tesi di dottorato tratta: Articolo A) L'enorme potenziale di questa promettente tecnologia in scenari realistici sia indoor che outdoor, proponendo anche delle soluzioni di implementazione flessibili ed a basso costo. Articolo B) Come preservare la scalabilità del sistema, proponendo soluzioni distribuite riguardanti il processamento e la condivisione dei dati, l'architettura di rete e l'allocazione di potenza, ovvero come ottimizzare i livelli di potenza trasmessa dagli access points per ridurre l'interferenza tra utenti e migliorare le performance. Articolo C) Come migliorare l'efficienza spettrale in downlink (da access point verso utente) proponendo due schemi di pre-codifica dei dati di trasmissione, denominati local partial zero-forcing (ZF) e local protective partial ZF, che forniscono un perfetto compromesso tra cancellazione dell'interferenza tra utenti ed amplificazione del segnale desiderato. Articolo D) Come migliorare l'efficienza spettrale in downlink permettendo al terminale utente di stimare le informazioni sulle condizioni istantanee del canale da sequenze pilota, piuttosto che basarsi su informazioni statistiche ed a lungo termine, come convenzionalmente previsto. Articolo E) In alternativa alla soluzione precedente, uno schema di pre-codifica che è più adatto al caso in cui gli utenti hanno a disposizione esclusivamente informazioni statistiche sul canale per poter effettuare la decodifica dei dati. Articolo F) Un metodo per permettere agli access points di stimare, in maniera rapida, le condizioni di canale su base statistica, favorito da uno schema di trasmissione delle sequenze pilota basato su rotazione di fase. Realizzare un sistema cell-free massive MIMO pratico, distribuito, scalabile e performante non è una utopia. Oggi questo concept rappresenta un argomento di ricerca interessante, attraente e stimolante ma in futuro potrebbe costituire un fattore chiave per le tecnologie post-5G, proprio come massive MIMO lo è stato per il 5G. Den femte generationens mobilkommunikationssystem (5G) är numera en verklighet. 5G-nätverk är utplacerade på ett flertal platser världen över och de första 5G-kapabla terminalerna (såsom smarta telefoner, surfplattor, kroppsburna apparater, etc.) är redan kommersiellt tillgängliga. 5G-systemen kan tillhandahålla tidigare oöverträffade nivåer av uppkoppling och servicekvalitet och är designade för en fortsatt oavbruten tillväxt i antalet uppkopplade apparater och ökande datataktskrav. Massiv MIMO-teknologi (eng: multiple-input multiple-output) spelar en

nyckelroll i dagens 5G-system. Principen bakom denna teknik är användningen av ett stort antal samlokaliserade antenner vid basstationen, där alla antennerna sänder och tar emot signaler faskoherent till och från flera användare. Gemensam signalbehandling av många antennsignaler ger ett flertal fördelar, såsom hög riktverkan via lobformning, vilket leder till högre datatakter samt möjliggör att flera användare utnyttjar samma radioresurser via rumslig användarmultiplexering. Eftersom en signal kan gå genom flera olika, möjligen oberoende kanaler, så utsätts den för flera olika förändringar samtidigt. Denna mångfald ökar kvaliteten på signalen vid mottagaren och förbättrar radiolänkens robusthet och tillförlitlighet. Detta gör det möjligt att uppfylla de höga kraven på servicekvalitet som fastställts för 5G-systemen. Den största begränsningen för massiva MIMO-system såväl som för alla cellulära mobilnätverk, är störningar från andra celler som påverkar användare på cellkanten väsentligt, vars prestanda redan begränsas av sträckdämpningen på radiokanalen. För att övervinna dessa begränsningar och för att kunna tillhandahålla samma utmärkta servicekvalitet till alla användare behöver vi ett mer radikalt angreppssätt: vi måste utmana cellparadigmet. I detta avseende utgör cellfri massiv-MIMO teknik ett paradigmskifte. I cellfri massive-MIMO är utgångspunkten inte att basstationen är omgiven av användare som den betjänar, utan snarare att varje användare omges av basstationer som de betjänas av. Dessa basstationer, ofta mindre och enklare, kallas accesspunkter (AP). I ett sådant system upplever varje användare att den befinner sig i centrum av systemet och ingen användare upplever några cellgränser. Därav terminologin cellfri. Som ett resultat av detta påverkas inte användarna av inter-cellstörningar och sträckdämpningen reduceras kraftigt på grund av närvaron av många accesspunkter i varje användares närhet. Detta leder till imponerande prestanda. Även om det är tilltalande ur ett prestandaperspektiv så är utformningen och implementeringen av ett sådant distribuerat massivt MIMO-system en utmanande uppgift, och det är syftet med denna avhandling att studera detta. Mer specifikt studerar vi i denna avhandling: A) den mycket stora potentialen med denna teknik i realistiska inomhus- såväl som utomhusscenarier, samt hur man hanterar praktiska implementeringsproblem, såsom klocksynkronisering bland accesspunkter och kostnadseffektiva implementeringar; B) hur man ska uppnå skalbarhet i systemet genom att föreslå lösningar relaterade till databehandling, nätverkstopologi och effektkontroll; C) hur man ökar datahastigheten i nedlänken med hjälp av två nyutvecklade distribuerade överföringsmetoder som tillhandahåller en avvägning mellan störningsundertryckning och förstärkning av önskade signaler, utan att öka mängden intern signalering till de distribuerade accesspunkterna, och som kan implementeras i accesspunkter med mycket få antenner; D) hur man kan förbättra prestandan ytterligare genom att låta användaren estimera nedlänkskanalen med hjälp av nedlänkspiloter, istället för att bara förlita sig på kunskap om kanalstatistik; E) en överföringsmetod för nedlänk som är mer lämpligt när endast kanalstatistiken är tillgänglig för användarna. Prestandan som uppnås genom detta schema jämförs med en utökad variant av den nedlänk-pilotbaserade metoden (beskrivet i föregående punkt); F) en metod för att uppskatta kanalstatistiken i upplänken, samt en åtföljande pilotsändningsmetod, som är särskilt användbart vid direktvägsutbredning (line-of-sight) och i scenarier med resursbegränsningar. Den övergripande slutsatsen är att cellfri massiv MIMO inte är en utopi, och att ett distribuerat, skalbart, samt högpresterande system kan implementeras praktiskt. Idag representerar detta ett hett forskningsämne, men snart kan det visa sig vara en viktig möjliggörare för teknik bortom dagens system, på samma sätt som centraliserad massiv MIMO har varit för de nya 5G-systemen.

This book constitutes the refereed proceedings of the 23rd International IFIP conference on Optical Network Design and Modeling, ONDM 2019, held in Athens, Greece, in May 2019. The 39 revised full papers were carefully reviewed and selected from 87 submissions. The papers focus on cutting-edge research in established areas of optical networking as well as their adoption in support of a wide variety of new services and applications. This involves the most recent trends in networking including 5G and beyond, big data and network data analytics, cloud/edge computing, autonomic networking, artificial intelligence assisted networks, secure and resilient networks, that drive the need for increased capacity, efficiency, exibility and adaptability in the functions that the network can perform. In this context new disaggregated optical network architectures were discussed, exploiting and integrating novel multidimensional photonic technology solutions as well as adopting open hardware and software platforms relying on software defined networking (SDN), and network function virtualization (NFV) to allow support of new business models and opportunities.

Discover how to design, deliver, and implement high-density communications solutions High-Density Smart Campus Communications: Technologies, Integration, Implementation and Applications delivers a concise synthesis of the deployment technologies, strategies, and implementation issues that arise in the design and application of real-world high-density communications environments in airports, stadiums, convention centers, shopping malls, classrooms, hospitals, cruise ships, and more. You'll learn future-oriented strategies for the implementation of next-generation Wi-Fi and 5G communications networks in high density environments, like smart airposrts, advanced airport robotics, and wayfinding. You'll also discover effective deployment strategies using a comprehensive case study based on a top-10 airport deployment by the Slice Wireless team. The book includes information about security requirements, large and boutique solution providers, applications, unbundled services, implementation planning and design, as well as operations and network management. An epilogue written by Josie Jo-Anne Dressendofer of Slice Wireless concludes the text. Readers will also benefit from the inclusion of: A thorough introduction to background and functional requirements for high density communications, including requirements for airports, stadiums, convention centers, classrooms, train and subway stations, and smart cities An exploration of traditional voice and cellular technology, including DAS designs and architectures and microcellularization Practical discussions of traditional data and Wi-Fi, including throughput/interference and security A treatment of evolved hotspot connectivity, including Wi-Fi and 5G Perfect for telecommunication researchers and engineers, networking professionals, technology professionals, campus administrators, and equipment vendors, High-Density Smart Campus Communications will also earn a place in the libraries of senior undergraduate and graduate students in applied communications technologies.

This exciting new book delivers a comprehensive overview of the cellular network architecture, with focus on the positioning applications and emergency call services, and covers aspects brought by 5G, including the core virtualization and the network slicing to optimize cellular network deployments. Focus is given to the different positioning technologies used in cellular networks, divided in satellite positioning, terrestrial radio positioning, non-RF positioning and a brief introduction to sensor fusion and Bayesian theory. It provides an overview of all the positioning technologies used in cellular networks, from GSM to 5G, from RAT independent technologies, such as A-GNSS (including GNSS evolution, RTK and PPP), WiFi, Bluetooth and sensor fusion, to cellular network native technologies, such as OTDOA / DL-TDOA, ECID, multi-cell RTT and the Angle Of Arrival (AOA) based techniques that take advantage of 5G mmWave beamforming features. Different positioning protocols, especially the LTE Positioning Protocol (LPP), which is used for LTE and 5G NR and defines the communication

between the user device (mobile phone, connected vehicle, etc.) and the base station are explained extensively, and compares it with other competing protocols such as OMA LPPE. Furthermore, it also explains the core network positioning protocols (LPPa, NRPPa), that describe the communication between the location server and the core network. Explanation of different signaling parameters will enable the reader to understand better how positioning works in a cellular network. The contents of this book are aimed at all types of users, from beginners to the concept of positioning to experts that are looking to enhance their knowledge of positioning in cellular networks.

How 5G technology can support the demands of multiple vertical industries Recent advances in technologyhave created new vertical industries that are highly dependent on the availability and reliability of data between multiple locations. The 5G system, unlike previous generations, will be entirely data driven—addressing latency, resilience, connection density, coverage area, and other vertical industry criteria. Enabling 5G Communication Systems to Support Vertical Industries demonstrates how 5G communication systems can meet the needs unique to vertical industries for efficient, cost-effective delivery of service. Covering both theory and practice, this book explores solutions to problems in specific industrial sectors including smart transportation, smart agriculture, smart grid, environmental monitoring, and disaster management. The 5G communication system will have to provide customized solutions to accommodate each vertical industry's specific requirements. Whether an industry practitioner designingthe next generation of wireless communications or a researcher needing to identify open issues and classify their research, this timely book: Covers the much-discussed topics of supporting multiple vertical industries and new ICT challenges Addresses emerging issues and real-world problems surrounding 5G technology in wireless communication and networking Explores a comprehensive array of essential topics such as connected health, smart transport, smart manufacturing, and more Presents important topics in a clear, concise style suitable for new learners and professionals alike Includes contributions from experts and industry leaders, system diagrams, charts, tables, and examples Enabling 5G Communication Systems to Support Vertical Industries is a valuable resource telecom engineers industry professionals, researchers, professors, doctorate, and postgraduate students requiring up-to-date information on supporting vertical industries with 5G technology systems.

Nowadays energy crisis and global warming problems are hanging over everyone's head, urging much research work on energy saving. In the ICT industry, which is becoming a major consumer of global energy triggered by the telecommunication network operators experiencing energy cost as a significant factor in profit calculations, researchers have start

This book presents design methods and considerations for digitally-assisted wideband millimeter-wave transmitters. It addresses comprehensively both RF design and digital implementation simultaneously, in order to design energy- and cost-efficient high-performance transmitters for mm-wave high-speed communications. It covers the complete design flow, from link budget assessment to the transistor-level design of different RF front-end blocks, such as mixers and power amplifiers, presenting different alternatives and discussing the existing trade-offs. The authors also analyze the effect of the imperfections of these blocks in the overall performance, while describing techniques to correct and compensate for them digitally. Well-known techniques are revisited, and some new ones are described, giving examples of their applications and proving them in real integrated circuits.

This comprehensive new resource presents the latest developments in key Software-Defined Network (SDN) technologies including SDN controllers, network control and management applications, southbound protocols, and northbound interfaces. NFV technologies are reviewed, including network function virtualization infrastructure, virtualized network functions, virtual network management and orchestration. Professionals find comprehensive discussions on the relationship between SDN and NFV and how they may integrate into unified future network architecture. Virtualization network services including, cloud, carrier Ethernet services, and IP VPN services are also covered.

This book will help readers comprehend technical and policy elements of telecommunication particularly in the context of 5G. It first presents an overview of the current research and standardization practices and lays down the global frequency spectrum allocation process. It further lists solutions to accommodate 5G spectrum requirements. The readers will find a considerable amount of information on 4G (LTE-Advanced), LTE-Advance Pro, 5G NR (New Radio); transport network technologies, 5G NGC (Next Generation Core), OSS (Operations Support Systems), network deployment and end-to-end 5G network architecture. Some details on multiple network elements (end products) such as 5G base station/small cells and the role of semiconductors in telecommunication are also provided. Keeping trends in mind, service delivery mechanisms along with state-of-the-art services such as MFS (mobile financial services), mHealth (mobile health) and IoT (Internet-of-Things) are covered at length. At the end, telecom sector's burning challenges and best practices are explained which may be looked into for today's and tomorrow's networks. The book concludes with certain high level suggestions for the growth of telecommunication, particularly on the importance of basic research, departure from ten-year evolution cycle and having a 20–30 year plan. Explains the conceivable six phases of mobile telecommunication's ecosystem that includes R&D, standardization, product/network/device & application development, and burning challenges and best practices Provides an overview of research and standardization on 5G Discusses solutions to address 5G spectrum requirements while describing the global frequency spectrum allocation process Presents various case studies and policies Provides details on multiple network elements and the role of semiconductors in telecommunication Presents service delivery mechanisms with special focus on IoT

The book covers a wide range of wireless communication and network technologies, and will help readers understand the role of wireless technologies in applications touching on various spheres of human life, e.g. healthcare, agriculture, building smart cities, forecasting and the manufacturing industry. The book begins by discussing advances in wireless communication, including emerging trends and research directions for network technologies. It also highlights the importance of and need to actively develop these technologies. In turn, the book addresses different algorithms and methodologies which could be beneficial in implementing 5G Mobile Communication, Vehicular Ad-hoc Networks (VANET), Reliable Cooperative Networks, Delay Tolerant Networks (DTN) and many more contexts related to advanced communications. It then addresses the prominence of wireless communication in connection with the Internet of Things (IoT), Mobile Opportunistic Networks and Cognitive Radio Networks (CRN). Lastly, it presents the new horizons in architecture and building protocols for Li-Fi (Light-Fidelity) and Wearable Sensor Technology.

Industrial internet of things (IIoT) is changing the face of industry by completely redefining the way stakeholders, enterprises, and machines connect and interact with each other in the industrial digital ecosystem. Smart and connected factories, in which all the machinery transmits real-time data, enable industrial data analytics for improving operational efficiency, productivity, and industrial processes, thus creating new business opportunities, asset utilization, and connected services. IIoT leads factories to step out of legacy environments and arcane processes towards open digital industrial ecosystems. Innovations in the Industrial Internet of Things (IIoT) and Smart Factory is a pivotal reference source that discusses the development of models and algorithms for predictive control of industrial operations and focuses on optimization of industrial operational efficiency, rationalization, automation, and maintenance. While highlighting topics such as artificial intelligence, cyber security, and data collection, this book is ideally designed for engineers, manufacturers, industrialists, managers, IT consultants, practitioners, students, researchers, and industrial industry professionals.

Opportunities are at hand for professionals eager to learn and apply the latest theories and practices in air interface technologies. Written by experienced researchers and professionals, LTE-Advanced Air Interface Technology thoroughly covers the performance targets and technology components studied by 3GPP for LTE-Advanced. Besides being an explanatory text about LTE-Advanced air interface technology, this book exploits the technical details in the 3GPP specification, and explains the motivation and implication behind the specifications. After a general description of wireless cellular technology evolution and the performance targets and major technical features

of LTE-Advanced, LTE-Advanced Air Interface Technology discusses various innovative technical features in detail, including Innovative concepts in carrier aggregation techniques Collaborative multipoint (CoMP) theory and performance analysis Enhanced multiantenna solutions or multiple-input, multiple-output (MIMO) technology, in particular, multiuser and multilayer MIMO Relaying issues Self-organizing and heterogeneous networks Interference suppression and enhanced intercell interference coordination (eICIC) technology This book opens the door of LTE-A technology for practitioners in any stage of wireless communications. Beginning with basic communication principles, the book demonstrates how a complete wireless theory is built. Readers can work independently on original case studies and simulation programming examples, with an emphasis on technology and performance. Designed for professionals interested in gaining an upper hand, this book is the ideal educational and informative resource in the emerging field of air interface technology.

"Optical Communications in the 5G Era provides an up-to-date overview of the emerging optical communication technologies for 5G wireless networks. It outlines the emerging applications of optical networks in supporting future wireless networks, state-of-the-art optical communication technologies, and explores new R&D opportunities in the field of converged fixed-mobile networks. This book is an ideal reference for university researchers, graduate students, and industry R&D engineers in optical communications, photonics, and wireless communications who need a broad and deep understanding of modern optical communication technologies, systems, and networks that are fundamental to 5G and beyond." • Describes 5G wireless trends and technologies such as cloud radio access networks (C-RAN), massive multiple-input and multiple-output (MIMO), and coordinated multipoint (CoMP) • Gives an insight into recent advances on the common public radio interface (CPRI), the evolved CPRI (eCPRI), and the open radio access networks (O-RAN) interface • Presents X-haul technologies and how transportation technologies can satisfy the mobile network requirements • Describes recent technological advances in access, aggregation, metro, data center, backbone, and undersea optical networks • Discusses the vision and use cases of the 5th generation fixed network (F5G) to help realize a fully connected, intelligent world for the benefit of our global society

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 Industriesprovides 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.

Systematically introduces self-healing control theory for distribution networks, rigorously supported by simulations and applications • A comprehensive introduction to self-healing control for distribution networks • Details the construction of self-healing control systems with simulations and applications • Provides key principles for new generation protective relay and network protection • Demonstrates how to monitor and manage system performance • Highlights practical implementation of self-healing control technologies, backed by rigorous research data and simulations

LTE network capabilities are enhanced with small cell deployment, with optimization and with new 3GPP features. LTE networks are getting high loaded which calls for more advanced optimization. Small cells have been discussed in the communications industry for many years, but their true deployment is happening now. New 3GPP features in Release 12 and 13 further push LTE network performance. This timely book addresses R&D and standardization activities on LTE small cells and network optimization, focusing on 3GPP evolution to Release 13. It covers LTE small cells from specification to products and field results; Latest 3GPP evolution to Release 13; and LTE optimization and learnings from the field.

A comprehensive guide to cable materials, markets, and products The Global Cable Industry presents a comprehensive overview of the most recent developments in automotive cables, nuclear power station cables, undersea cables, coaxial cables, optical wires, medium- and high-voltage cables. With contributions from noted researchers and developers in the field, the book includes information on material developments for polymers, crosslinked elastomers and flame retardant non-halogen cable compounds. The contributors provide information on technologies to crosslink polymers, an overview of foam polymers, and field experiences of the new cable fire test within the Construction Product Regulation framework. In addition, this comprehensive resource contains the most relevant economic questions related to the cable industry that highlights materials, market segments, and countries. This important book: Includes contributions from researchers and developers of key companies in the cable industry Presents information on the most recent developments in the field Covers the most industry-relevant cable types such as automotive, nuclear power cables, undersea, coaxial, optical, medium- and high-voltage cables Written for power engineers, materials scientists, chemists and engineering scientists in industry, The Global Cable Industry is an up-to-date guide to the multi-billion-dollar cable enterprise.

This book provides a comprehensive overview of the latest research and standardization progress towards the 5th generation (5G) of mobile communications technology and beyond. It covers a wide range of topics from 5G use cases and their requirements, to spectrum, 5G end-to-end (E2E) system architecture including core network (CN), transport network (TN) and radio access network (RAN) architecture, network slicing, security and network management. It further dives into the detailed functional design and the evaluation of different 5G concepts, and provides details on planned trials and pre-commercial deployments across the globe. While the book naturally captures the latest agreements in 3rd Generation Partnership Project (3GPP) New Radio (NR) Release 15, it goes significantly beyond this by describing the likely developments towards the final 5G system that will ultimately utilize a wide range of spectrum bands, address all envisioned 5G use cases, and meet or exceed the International Mobile Telecommunications (IMT) requirements for the year 2020 and beyond (IMT-2020). 5G System Design: Architectural and Functional Considerations and Long Term Research is based on the knowledge and consensus from 158 leading researchers and standardization experts from 54 companies or institutes around the globe, representing key mobile network operators, network vendors, academic institutions and regional bodies for 5G. Different from earlier books on 5G, it does not focus on single 5G technology components, but describes the full 5G system design from E2E architecture to detailed functional design, including details on 5G performance, implementation and roll-out.

Provides an introduction to the technical and business aspects of mobile telecommunications, exploring the complete eco-system of the industry with the key segments and how they interact with each other. This industry has seen rapid technical advancements in recent years, yet the basics of providing coverage and capacity to the end users have not changed. The authors introduce these technical basics to the reader and then show how a network is deployed. Technical innovation has been pivotal to the rapid advancement of this industry and the book details some of the main innovations over the years. The book highlights some of the current challenges the industry is facing and how innovation is driven by these challenges. Mobile operators business structures are examined, from the purchasing spectrum to deploying the network and attracting and retaining customers. The role of the regulator is not overlooked, and its role in ensuring a competitive market

where consumers have sufficient choice. The authors detail current challenges faced by the operators and how they are using business innovation to overcome these challenges. In describing the changing face of mobile telecoms, the book covers business challenges as well as the technological challenges faced today by the industry. The advent of the Smart phones, which support multiple technologies that compliment and sometimes compete with mobile cellular technology has had a profound impact on the industry, sometimes challenging the role of the mobile operator. A discussion of these yet-unanswered challenges provides some insight into where the industry is heading. The technical aspects of this book are pitched at undergraduate first year mathematics and physics subject levels, making it easily comprehensible to the undergraduate students studying relevant fields. As the title denotes, this book will be at an introductory level, giving a broad coverage to many of the significant technical and business aspects of the industry.

The pioneers of Flash-OFDM present OFDMA from first principles, enabling readers to apply theory to practice and understand mobile broadband.

This book constitutes the refereed proceedings of the 9thInternational Conference on Cloud Computing, CloudComp 2019, and the 4th International Conference on Smart Grid and Innovative Frontiers in Telecommunications, SmartGIFT 2019, both held in Beijing, China, in December 2019. The55 full papers of both conferences were selected from 113 submissions. CloudComp 2019 presents recent advances and experiences in clouds, cloud computing and related ecosystems and business support. The papers are grouped thematically in tracks on cloud architecture and scheduling; cloud-based data analytics; cloud applications; and cloud security and privacy. SmartGIFT 2019 focus on all aspects of smart grids and telecommunications, broadly understood as the renewable generation and distributed energy resources integration, computational intelligence applications, information and communication technologies.

This cutting-edge, first-of-its-kind resource gives you a comprehensive understanding of the simulation and evaluation methods used for today's mobile communication systems. Written by two highly regarded experts in the field, the book focuses on the performance of both the physical and protocol layer transmission scheme. It defines and presents several invaluable simulation tools written in MATLAB® code, along with clear examples that explain their use.

This SpringerBriefs is an overview of the emerging field of wireless access and mobile network virtualization. It provides a clear and relevant picture of the current virtualization trends in wireless technologies by summarizing and comparing different architectures, techniques and technologies applicable to a future virtualized wireless network infrastructure. The readers are exposed to a short walkthrough of the future Internet initiative and network virtualization technologies in order to understand the potential role of wireless virtualization in the broader context of next-generation ubiquitous networks. Three main wireless virtualization perspectives are explored, along with the potential challenges and requirements of a sustainable wireless virtualization framework. Finally, it presents an example of a multi-perspective wireless virtualization framework. The readers learn the latest concepts in the application of wireless virtualization as well as its relationship with cutting-edge wireless technologies such as software-defined radio (SDR) and cognitive radio.

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.

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