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Spectral Efficiency of Next Generation Mobile Communication Systems **Spectral Efficiency of Cellular Land Mobile Radio Systems** **Principles of LED Light Communications** Spectral efficiency of CDMA based ad-hoc networks Improving Secrecy and Spectral Efficiency of Wireless Communications *Spatial Spectral Efficiency Analysis for Wireless Communications* **Improving the Spectral Efficiency of Wireless Communication Systems Based on New Duplexing Techniques** The Spectral Efficiency of CDMA in a PCN Environment Spectral Efficiency of FM and ACSB Radios **On the Spectral Efficiency of Interference Limited Mobile Radio Systems with Space, Time, Code Division Multiple Access** Energy and Spectral Efficiency in Wireless Heterogeneous Networks **Receiver Design for High Spectral Efficiency Communication Systems in Beyond 5G** *Spectral Efficiency in Cellular Land-mobile Communications* Spectral Efficiency of CDMA with Random Spreading Spectral Efficiency of Amplitude Companded Sideband Systems *On the Spectral Efficiency of MIMO Ad-Hoc Networks* **Spectral Efficiency in Satellite Communications** *Achievable Energy Efficiency and Spectral Efficiency of Large- Scale Distributed Antenna Systems* *Spectral Efficiency of MIMO Ad Hoc Networks with Partial Channel State Information* **Adaptive MIMO-OFDM System for Spectral Efficiency of Wireless System** *Spectrum Efficiency Improvements Via PHY-layer and PDCP-layer Techniques* Spectral Efficiency and Spectral Shaping of Faster-Than-Nyquist Signals **Improvement in Spectral Efficiency for Wireless Emergency Communications** Spectral Efficiency Maximization of a Massive Multiuser MIMO System Via Appropriate Power Allocation Spectral Efficiency in Mobile Overlay Networks **Enabling Technologies for High Spectral-efficiency Coherent Optical Communication Networks** **Spectral Efficiency of Joint Multiple Cell-site Processors for Randomly Spread DS-CDMA Systems** Techniques to Enhance Spectral Efficiency of OFDM Wireless Systems **Experimental Evaluation of Downlink Spectral Efficiency in Indoor Environment for LTE Cellular Network** Spectral Efficiency Enhancement Technologies for Future Reliability-Aware Wireless Communication Systems *Noncoherent Fading Channels* Fundamental Trade-off Between Energy Efficiency and Spectral Efficiency in Cellular Networks *Turbo Code Design for High Spectral Efficiency* **Space-time Turbo Coding for High Spectral Efficiency Wireless Communications** *Maximization of Spectral Efficiency in Packet-switched Wavelength Division Multiplexing Metropolitan Area Networks* **Spectral Efficiency and Optimal Base Placement for Indoor Wireless Networks** **Radio Resource Management and System Spectral Efficiency in LTE Multi-Cell Systems** Spectral Efficiency **Increasing the Spectral Efficiency of Continuous Phase Modulation Applied to Digital Microwave Radio** *Coding*

This book focuses on the receiver design issue in high spectral efficiency communication systems, which is one of the main research directions in beyond 5G and 6G era. In particular, this book studies two technologies to improve the spectral efficiency, i.e., FTN signaling which transmits more data information in the same time period and NOMA scheme which supports more users with the same resource elements. Different commonly used channel propagation conditions are considered, and advanced signal processing algorithms have been developed for designing receivers, which is suitable for low-complexity receiver design in engineering practice. Moreover, this book discusses possible solutions to further increase spectral efficiency and propose practical receivers in such scenarios. It benefits researchers, engineers, and students in the fields of wireless communications and signal processing. The focus of this dissertation is investigating energy and spectral efficiency in wireless heterogeneous networks (HetNets). Our goal is to improve the energy efficiency and spectral efficiency of the HetNets while satisfying the minimum rate requirements of the users. The contributions of this dissertations are (i) to develop an energy-efficient base station deployment framework for HetNets, (ii) to increase energy efficiency of the HetNets while satisfying minimum rate requirements of users, and (iii) to investigate energy efficiency-spectral efficiency tradeoff in HetNets. First, we address the micro base station deployment problem in HetNets. Although micro base station deployment increases the total capacity of the network, increasing the number of micro base stations excessively may reduce the energy efficiency of the network. Therefore, we examine the energy efficiency aspect of the micro base station deployment problem. We propose a greedy deployment algorithm which is a constant-factor approximation of the optimal solution. Second, we investigate the energy efficiency of downlink transmission in multi-cell HetNets. Our objective is to satisfy the rate requirement of users while maximizing energy efficiency of the network. We divide the problem into three subproblems: cell-center region boundary selection for fractional frequency reuse (FFR), scheduling, and power allocation subproblems. We propose a three-stage algorithm, and apply it iteratively until convergence. We demonstrate that significant gains can be achieved in terms of energy efficiency and outage probability using the proposed algorithm. Third, we investigate the energy efficiency-spectral efficiency tradeoff in multi-cell HetNets. Our objective is to maximize both energy efficiency and spectral efficiency of the network while satisfying the rate requirements of users. We define our objective function as the weighted summation of energy efficiency and spectral efficiency. We derive the Pareto optimal solution that strikes a balance between the spectral efficiency and energy efficiency. Cellular services have been ineffective in providing defense and disaster recovery communications, no matter how important the user is. This has led to the emergence of Wireless Priority Services for disaster communication, which dynamically prioritizes some connections. Future generation Wireless Priority Services must support a large number of calls. This can be achieved by making the system spectrally efficient. We propose to use linear, higher order modulation techniques for priority services instead of the currently deployed non-linear modulation schemes for priority and non-priority services. The proposed modulation techniques increase spectrum efficiency as needed but suffer from increased Adjacent Channel Interference and Inter Symbol Interference. This work deals with modelling of Adjacent Channel Interference and methods to reduce the same using digital filters. Finally we cite references which help explain how to incorporate the linear modulation schemes and interference minimizing filters into the existing GSM system using Software Defined Radio. Learn how to build efficient, simple, high performance indoor optical wireless communication systems based on visible and infrared light. The past decades have witnessed an ever-growing demand for higher network capacity. Given practical radio resource constraints such as bandwidth and power, a wide variety of spectral efficiency techniques have been thoroughly explored by research efforts around the world. In this dissertation, we examine two less conventional approaches to boost the performance of wireless networks at two different layers of a communication system, one focused on the physical layer/symbol level while the other focused on the network layer/packet level. In the first part, we study the linear precoder design for cooperative multi-cell MIMO (MC-MIMO) networks. Different from the previous related works with the simplified yet less practical assumption that all input signals are Gaussian distributed, we take into consideration the finite-alphabet (FA) nature of the input signal generated from digital modulation schemes such as QAM, PSK, etc. We propose two different algorithms to design linear precoders for down link channels with low complexity and distributed implementations. Monte-Carlo simulations demonstrate that our proposed schemes significantly outperform the conventional ones with the Gaussian input assumptions in terms of average capacity and bit error rate. Noting that most spectral efficiency techniques including our first work focus on PHY/MAC layers and there is insufficient understanding in optimizing the wireless protocol stack as a whole, in the second part of dissertation, we study a critical aspect of all IP-based wireless networks located between the network layer and the wireless infrastructure, namely RObust Header Compression (ROHC), from a trans-layer point of view. The optimal control of compression level adjustment, feedback request, etc., based on imperfect and delayed trans-layer information, are formulated into partially observable Markov Decision processes (POMDPs). To address the complexity issue associated with POMDP, we also propose myopic policies with simple implementation and close-to optimal performances. Simulation results show that our trans-layer ROHC scheme can greatly improve the transmission efficiency of packet-switched wireless links, with little or no modification to the wireless protocol stacks. Massive multiuser multiple-input multiple-output (MU-MIMO) systems are being considered for the next generation wireless networks in view of their ability to increase both the spectral and energy efficiencies. For such systems, linear detectors such as zero-forcing (ZF) and maximum-ratio combining (MRC) detectors on the uplink (UL) transmission have been shown to provide near optimal performance. As well, linear precoders such as ZF and maximum-ratio transmission (MRT) precoders on the downlink (DL) transmission offer lower complexity along with a near optimal performance in these systems. One of the most challenging problems in massive MU-MIMO systems is obtaining the channel state information (CSI) at the transmitter as well as the receiver. In such systems, the base station (BS) obtains CSI using pilot sequences, which are transmitted by the users. Due to the channel reciprocity between the UL and DL channels in the time-division duplex (TDD) mode, BS employs CSI obtained to precode the data symbols in DL transmission. To accurately decode the received symbols in the DL transmission, the users also need to acquire CSI. In view of this, a beamforming training (BT) scheme has been proposed in the literature to obtain the estimates of CSI at each user. In this scheme, BS transmits a short pilot sequence to the users in a way such that each user estimates the effective channel gain. Conventionally, the power of the pilot symbols has been considered equal to the power of data symbols for all the users. In this thesis, we pose and answer a basic question about the operation of a base station: How much the spectral efficiency could be improved if the transmit power allocated to the pilot and data symbols of each user are chosen in some optimal fashion? In answering this question and in order to maximize the spectral efficiency for a given total energy budget, some methods of power allocation are proposed. First, we derive a closed-form approximate expression for the achievable downlink rate for the maximum ratio transmission precoder based on small-scale fading in order to evaluate the spectral efficiency in the BT scheme. Then, we propose three methods of power allocation in order to maximize the spectral efficiency for a given total power budget among the users. In the first proposed method, we allocate equal pilot power as well as equal data power for all users in order to maximize the spectral efficiency. In the second proposed method, we allow for the allocation of different data powers among the users, whereas the pilot power for each user is kept the same and is specified. In the third method, we optimally allocate equal pilot power and a different data power for each user in such a way that the spectral efficiency is maximized. Numerical results are obtained showing that all the three proposed methods are superior to the existing methods in terms of spectral efficiency. In addition, they also show that the third proposed method of power allocation outperforms the other two proposed methods in terms of the spectral efficiency. Next, we derive a closed-form approximate expression for the achievable downlink rate for the maximum ratio transmission precoder based on large-scale fading in order to evaluate the spectral efficiency in the BT scheme. Then, we propose four methods of power allocation in order to maximize the spectral efficiency for a given total power budget among the users. In the first method, power is allocated among the pilot and data symbols in such a way that the pilot power as well as the data power for each user is the same. In the second method, power is allocated among the data symbols of the various users, whereas the pilot power for each user is the same and is specified. In this method, the data power for each user is optimally determined to maximize the spectral efficiency. In the third method, power is allocated among the pilot and data symbols of the various users, whereas the pilot power for each user is the same but determined. In this method, the same pilot power along with the various data powers is optimized to maximize the spectral efficiency. Finally, in the fourth method, power is allocated optimally among each of the pilot and data symbols of the various users so as to maximize the spectral efficiency. Numerical results are obtained showing that the performance of the first proposed method is approximately the same as that of the conventional approach. In addition, they also show that the second, third and fourth methods of power allocation yield similar performance in terms of spectral efficiency, and that the spectral efficiency of these methods is much superior to that of the first method or of the conventional method. Finally, we investigate the spectral efficiency of massive MU-MIMO systems on an UL transmission with a very large number of antennas at the base station serving single-antenna users. A practical physical channel model is proposed by dividing the angular domain into a finite number of distinct directions. A lower bound on the achievable rate of the uplink data transmission is derived using a linear detector for each user and employed in defining the spectral efficiency. The lower bound obtained is further modified for the maximum-ratio combining and zero-forcing receivers. A power control scheme based on the large-scale fading is also proposed to maximize the spectral efficiency under the peak power constraint. Experiments are conducted to evaluate the lower bounds obtained and the performance of the proposed method. The numerical results show that the proposed power control method provides a spectral efficiency which is the same as that of the maximum power criterion using the ZF receiver. Further, the proposed method provides a spectral efficiency that is higher than that provided by the maximum power criterion using the MRC receiver. As the number of devices with wireless capabilities and the proximity of these devices to each other increases, better ways to handle the interference they cause need to be explored. Also important is for these devices to keep up with the demand for data rates while not compromising on industry established expectations of power consumption and mobility. Current methods of distributing the spectrum among all participants are expected to not cope with the demand in a very near future. In this thesis, the effect of employing sophisticated multiple-input, multiple-output (MIMO) systems in this regard is explored. The efficacy of systems which can make intelligent decisions on the transmission mode usage and power allocation to these modes becomes relevant in the current scenario, where the need for performance far exceeds the cost expendable on hardware. The effect of adding multiple antennas at either ends will be examined, the capacity of such systems and of networks comprised of many such participants will be evaluated. Methods of simulating said networks, and ways to achieve better performance by making intelligent transmission decisions will be proposed. Finally, a way of access control closer to the physical layer (a 'statistical MAC') and a possible metric to be used for such a MAC is suggested. Spectrum utilization efficiency is one of the primary concerns in the design of future wireless communication systems. Most performance metrics for wireless communication systems focus on either link level capacity or network throughput while ignore the spatial property of wireless transmissions. In this dissertation, we focus on the spatial spectral utilization efficiency of wireless transmissions. We first study the spatial spectral efficiency of single-cell and multi-cell wireless relay systems using area spectral efficiency (ASE) performance metric. We then generalize the performance metric, termed as generalized area spectral efficiency (GASE), to measure the spatial spectral utilization efficiency of arbitrary wireless transmissions. In particular, we first introduce the definition of GASE by illustrating its evaluation for conventional point-to-point transmission. Then we extend the analysis to four different transmission scenarios, namely dual-hop relay transmission, three-node cooperative relay transmission, two-user X channels, and underlay cognitive radio transmission. Finally, we apply the GASE performance metric to investigate the spatial spectral efficiency of wireless network with Poisson distributed nodes and quantify the spatial spectral opportunities that could be explored with secondary cognitive systems. Our research on the spatial spectral utilization efficiency provides a new perspective on the designing of wireless communication systems, especially on the transmission power optimization and space-spectrum resource exploitation. In the large-scale distributed antenna system (LS-DAS), a large number of antenna elements are densely deployed in a distributed way over the coverage area, and all the signals are gathered at the cloud processor (CP) via dedicated fiber links for globally joint processing. Intuitively, the LS-DAS can inherit the advantage of both large-scale multiple-input-multiple-output (MIMO) and network densification; thus, it offers enormous gains in terms of both energy efficiency (EE) and spectral efficiency (SE). However, as the number of distributed antenna elements (DAEs) increases, the overhead for acquiring the channel state information (CSI) will increase accordingly. Without perfect CSI at the CP, which is the majority situation in practical applications due to limited overhead, the claimed gain of LS-DAS cannot be achieved. To solve this problem, this chapter considers a more practical case with only the long-term CSI including the path loss and shadowing known at the CP. As the long-term channel fading usually varies much more slowly than the short-term part, the system overhead can be easily controlled under this framework. Then, the EE-oriented and SE-oriented power allocation problems are formulated and solved by fractional programming (FP) and geometric programming (GP) theories, respectively. It is observed that the performance gain with only long-term CSI is still noticeable and, more importantly, it can be achieved with a practical system cost. This thesis performs an analysis of the LTE network performance in indoor environment. The effects of the signal level and interference performance indicators on the throughput and spectral efficiency are analyzed. The analysis is based on the real world experimental data which were collected on a commercial LTE network and inside a shopping center located in Florida. The analysis determined that the performance indicators have significant and quantifiable effects on the user throughput and spectral efficiency. Therefore, these performance indicators need to be within certain levels to provide high quality user experience while making efficient use of the spectrum in an economical manner. Enabling Technologies for High Spectral-efficiency Coherent Optical Communication Networks Presents the technological advancements that enable high spectral-efficiency and high-capacity fiber-optic communication systems and networks This book examines key technology advances in high spectral-efficiency fiber-optic communication systems and networks, enabled by the use of coherent detection and digital signal processing (DSP). The first of this book's 16 chapters is a detailed introduction. Chapter 2 reviews the modulation formats, while Chapter 3 focuses on detection and error correction technologies for coherent optical communication systems. Chapters 4 and 5 are devoted to Nyquist-WDM and orthogonal frequency-division multiplexing (OFDM). In chapter 6, polarization and nonlinear impairments in coherent optical communication systems are discussed. The fiber nonlinear effects in a non-dispersion-managed system are covered in chapter 7. Chapter 8 describes linear impairment equalization and Chapter 9 discusses various nonlinear mitigation techniques. Signal synchronization is covered in Chapters 10 and 11. Chapter 12 describes the main constraints put on the DSP algorithms by the hardware structure. Chapter 13 addresses the fundamental concepts and recent progress of photonic integration. Optical performance monitoring and elastic optical network technology are the subjects of Chapters 14 and 15. Finally, Chapter 16 discusses spatial-division multiplexing and MIMO processing technology, a potential solution to solve the capacity limit of single-mode fibers. Contains basic theories and up-to-date technology advancements in each chapter Describes how capacity-approaching coding schemes based on low-density parity check (LDPC) and spatially coupled LDPC codes can be constructed by combining iterative demodulation and decoding Demonstrates that fiber nonlinearities can be accurately described by some analytical models, such as GN-EGN model Presents impairment equalization and mitigation techniques Enabling Technologies for High Spectral-efficiency Coherent Optical Communication Networks is a reference for researchers, engineers, and graduate students.

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