Preface

Nowadays, wireless networks are considered to be a significant and emerging part of the communication networks field. The current prevalent opinion is that in some years a considerable percentage of the data networks will be wireless networks. The same time, the network applications are evolving and become more resource demanding. Specifically, multimedia traffic tends to be a significant portion of the total network load, which leads to stricter transmission requirements. The modern time-bounded network applications need to be provided with high throughput, low delay, low jitter, and low loss/drop rate. Today, users expect that this type of high quality services can be offered by all kinds of communication networks. However, meeting strict transmission requirements under the harsh wireless environment, which is characterized by scarce bandwidth, unreliable links, and limited range, is quite challenging and it has actually formed a very active research field in the last years. A straightforward approach to this whole issue is the effort to physically maximize the available data rate and link quality. It is certain that there has been lately great development in the respective area, which has led to efficient signal modulation techniques and has definitely improved the overall performance of wireless data transmissions. However, the increasing demands necessitate global solutions that involve cross-layer approaches. Specifically, modern wireless networks need to provide total Quality of Service (QoS), which in practice means efficient differentiation of the offered traffic flows based on their nature and serving them according to their specific needs. This concept includes adaptive control of the physical layer, optimized medium access control for serving mixed-type traffic load, efficient routing algorithms that can provide end-to-end transport guarantees, and QoS-aware higher layer protocols which can be automatically adjusted to the user needs and the network limitations. Furthermore, part of the provided Quality of Experience (QoE) in a wireless network environment has become the available energetic autonomy of the mobile devices, thus, power conservation techniques are also considered to participate in the total QoS provision concept.

Cutting edge approaches for the provision of QoS in wireless local area networks are examined in this book. The Enhanced Distributed Channel Access (EDCA) and the Hybrid Control Channel Access (HCCA) protocols, which constitute the Hybrid Coordination Function (HCF), that is the Medium Access Control (MAC) scheme of the IEEE 802.11e standard, are discussed. The authors present latest solutions towards the optimization of the channel management and routing in infrastructure and ad hoc wireless networks. This book also analyzes traffic categorization issues and methods that can predict the available QoS. Moreover, cross-layer designs (especially PHY-MAC) are presented, which can efficiently serve multimedia traffic over wireless links. Energy conservation techniques for the maximization of the mobile devices' battery lifetime are also examined. Furthermore, the book introduces the reader to modern methods of managing wireless mesh networks and controlling wireless sensor networks.

State of the art mechanisms that ensure QoS support in wireless wide area networks are presented, too. Topology control issues for extended point-to-point wireless networks are examined. The book also

discusses the new IEEE 802.16 standard, known as WiMAX, focusing on traffic scheduling techniques. The reader can thoroughly study future network cooperation under the promising 4G architecture by examining issues related with allocating resources, managing new connections, and predicting the QoS level that can be offered. Additionally, the role of power control in supporting MBMS (Multimedia Broadcast / Multicast Service) services over 4G networks is analyzed.

The target audience of this book includes students on computer science and communications engineering that need a good background and understanding of the subject area, scholars and researchers whose area of interests is wireless networks – QoS and need a reliable reference for their study, and people working in the wireless communications industry and require a modern book that can support their effort to enhance their current services and develop new ones. The book can be proved valuable as a library reference, useful in computer science, informatics, electronic-electrical engineering, and communications engineering departments. It can also serve as a course supplement for graduate studies on computer networks, wireless communications, and multimedia applications. Instructors in the above mentioned scientific areas would find this book useful as a resource, when teaching (among others) about the evolution of wireless networks, the nature and characteristics of network traffic, resource management algorithms, medium access control protocols, multihop network control, network simulation techniques, and power saving trends.

The book is organized into two sections. Section 1 discusses QoS provision techniques for wireless networks that mainly target local area networks (WLANs). Chapter 1 presents the Priority Oriented Hybrid Access (POHA) scheme, which is formed by the combination of two different MAC protocols for WLANs. This scheme is examined in comparison to the hybrid MAC protocol defined in the IEEE 802.11e standard, HCF. Chapter 2 presents the Distributed Queueing Collision Avoidance (DQCA) MAC protocol for infrastructure wireless networks. Based on a cross-layer approach, four traffic scheduling algorithms are also proposed. Chapter 3 introduces a mechanism for strict QoS guarantee in WLANs. Its performance is examined compared to the defined IEEE 802.11e HCCA scheme. Chapter 4 proposes a dynamic queue length scheduling technique for wireless networks with heterogeneous traffic. It also examines the impact of modern multi-antenna solutions to the higher network layers. Chapter 5 describes traffic prediction models, including time series models, artificial neural network models, wavelet-based models, and support vector machine-based models. The authors study the application of a support vector machine in a WLAN and examine its behavior along with other models. Chapter 6 analyzes power consumption minimization of video transmission over wireless links. The authors adopt a cross-layer approach, which takes into account the video coding and the wireless communication process. Chapter 7 examines power saving issues related with medium access control and routing algorithms in wireless networks. The respective protocols proposed in the chapter are finally evaluated in comparison to other well-known protocols. Chapter 8 discusses modern end-to-end QoS support solutions. The authors study the issues raised by the coexistence of mobility management and MAC protocols. Chapter 9 describes the Control and Provisioning Wireless Access Protocol (CAPWAP), which is related with the management of centralized WLANs. The authors examine the possibility to use this protocol for QoS monitoring and adjusting. Chapter 10 provides a detailed overview of QoS provision in multi-hop ad-hoc networks. It presents related issues in each one of the physical, data link, and routing layers. Cross-layer approaches are also examined. Chapter 11 discusses heuristic geographic routing techniques for wireless networks. The authors introduce a new performance measure and compare the presented algorithms using simulation.

Section 2 discusses QoS provision techniques for wireless networks that mainly target wide area networks (WWANs). Chapter 12 presents topology control solutions in wireless mesh networks, in terms of employing power control or not. The authors present the Path Reduction (PR) algorithm that

is described via simulation. Chapter 13 is about QoS provision techniques in WiMAX networks. Various resource management schemes proposed for IEEE 802.16 networks are examined and evaluated. Chapter 14 provides a complete overview of the next generation wireless networks area. The 4G concept is examined and various techniques for QoS provision in a heterogeneous network environment are provided. Chapter 15 examines the process of predicting the QoS characteristics provided by the locally available networks in a 4G architecture. The specific case study involves a health tele-monitoring service. Chapter 16 analyzes the network selection problem inside a heterogeneous network environment. The authors present the latest approaches and introduce the application of the game theory concept in the specific subject area. Chapter 17 thoroughly examines the call admission control in wireless networks. The authors analytically study the performance of the available relative schemes focusing on the admission denying probability. Lastly, Chapter 18 presents the basic approaches in delivering MBMS content inside a 4G network architecture. The authors focus on power control adaptation issues when operating under variable network conditions.

In overall, this book aggregates technologies related to QoS support in wireless networks. This publication targets in explaining all related issues, the problems that arise when trying to provide different and demanding services over wireless networks, the theoretical background, the evolution of traditional related technologies and the solutions given so far, and moreover, the book presents the latest research concepts and relevant ideas regarding near-future implementations. The selected chapters cover most of the aspects of this modern and promising area that till now was usually presented in a segmental way in literature. Finally, this book could potentially become: a) a guidebook for readers entering the area of QoS support in wireless networks, b) a reference for scientists who need to gain up-to-date knowledge of the latest related technologies, and c) a source of ideas and new trends for researchers who work on the area of QoS provision in wireless networks.