

## Multimedia Networks Protocols Design And Applications

The Internet has changed significantly from its beginnings as a simple network used to pass data from one computer to another. Containing essential tools for everyday information processing, the Internet is used by small and large organizations alike and continues to evolve with the changing information technology landscape. Technologies and Protocols for the Future of Internet Design: Reinventing the Web aims to provide relevant methods and theories in the area of the Internet design. It is written for the research community and professionals who wish to improve their understanding of future Internet technologies and gain knowledge of new tools and techniques in future Internet design.

The transportation of multimedia over the network requires timely and errorless transmission much more strictly than other data. This had led to special protocols and to special treatment in multimedia applications (telephony, IP-TV, streaming) to overcome network issues. This book begins with an overview of the vast market combined with the user's expectations. The basic mechanisms of the audio/video coding (H.26x etc.) are explained to understand characteristics of the generated network traffic. Further chapters treat common specialized underlying IP network functions which cope with multimedia data in conjunction with special time adaptation measures. Based on those standard functions these chapters can treat uniformly SIP, H.248, High-End IP-TV, Webcast, Signage etc. A special section is devoted to home networks which challenge high-end service delivery due to possibly unreliable management. The whole book treats concepts described in accessible IP-based standards and which are implemented broadly. The book is aimed at graduate students/practitioners with good basic knowledge in computer networking. It provides the reader with all concepts of currently used IP technologies of how to deliver multimedia efficiently to the end user. ATM is regarded as the next high speed multimedia networking paradigm. Mobile computing, which is a confluence of mobile communications, computing and networks, is changing the way people work. Wireless ATM combines wireless and ATM technologies to provide mobility support and multimedia services to mobile users. Wireless ATM and Ad-Hoc Networks: Protocols and Architectures, a consolidated reference work, presents the state of the art in wireless ATM technology. It encompasses the protocol and architectural aspects of Wireless ATM networks. The topics covered in this book include: mobile communications and computing, fundamentals of ATM and Wireless ATM, mobile routing and switch discovery, handover protocol design and implementation, mobile quality of service, unifying handover strategy for both unicast and multicast mobile connections, and roaming between Wireless ATM LANs. A novel routing protocol for ad-hoc mobile networks (also known as Cambridge Ad-hoc) is also presented in this book along with information about ETSI HIPERLAN, the RACE Mobile Broadband System, and SUPERNET. This timely book is a valuable reference source for researchers, scientists, consultants, engineers, professors and graduate students working in this new and exciting field.

This book constitutes the refereed proceedings of the Joint International Workshops on Interactive Distributed Multimedia Systems and Protocols for Multimedia Systems, IDMS/PROMS 2002, held in Coimbra, Portugal in November 2002. The 30 revised full papers presented were carefully reviewed and selected from 112 submissions. The papers are organized in topical sections on performance of protocols and applications, mobile multimedia systems, standards and related issues, quality of service, video systems and applications, resource management, and multimedia support.

"This book presents state-of-the-art research, developments, and integration activities in combined platforms of heterogeneous wireless networks"--Provided by publisher.

Best-practice QoS designs for protecting voice, video, and critical data while mitigating network denial-of-service attacks  
Understand the service-level requirements of voice, video, and data applications  
Examine strategic QoS best practices, including Scavenger-class QoS tactics for DoS/worm mitigation  
Learn about QoS tools and the various interdependencies and caveats of these tools that can impact design considerations  
Learn how to protect voice, video, and data traffic using various QoS mechanisms  
Evaluate design recommendations for protecting voice, video, and multiple classes of data while mitigating DoS/worm attacks for the following network infrastructure architectures: campus LAN, private WAN, MPLS VPN, and IPsec VPN  
Quality of Service (QoS) has already proven itself as the enabling technology for the convergence of voice, video, and data networks. As business needs evolve, so do the demands for QoS. The need to protect critical applications via QoS mechanisms in business networks has escalated over the past few years, primarily due to the increased frequency and sophistication of denial-of-service (DoS) and worm attacks. End-to-End QoS Network Design is a detailed handbook for planning and deploying QoS solutions to address current business needs. This book goes beyond discussing available QoS technologies and considers detailed design examples that illustrate where, when, and how to deploy various QoS features to provide validated and tested solutions for voice, video, and critical data over the LAN, WAN, and VPN. The book starts with a brief background of network infrastructure evolution and the subsequent need for QoS. It then goes on to cover the various QoS features and tools currently available and comments on their evolution and direction. The QoS requirements of voice, interactive and streaming video, and multiple classes of data applications are presented, along with an overview of the nature and effects of various types of DoS and worm attacks. QoS best-practice design principles are introduced to show how QoS mechanisms can be strategically deployed end-to-end to address application requirements while mitigating network attacks. The next section focuses on how these strategic design principles are applied to campus LAN QoS design. Considerations and detailed design recommendations specific to the access, distribution, and core layers of an enterprise campus network are presented. Private WAN QoS design is discussed in the following section, where WAN-specific considerations and detailed QoS designs are presented for leased-lines, Frame Relay, ATM, ATM-to-FR Service Interworking, and ISDN networks. Branch-specific designs include Cisco® SAFE recommendations for using Network-Based Application Recognition (NBAR) for known-worm identification and policing. The final section covers Layer 3 VPN QoS design-for both MPLS and IPsec VPNs. As businesses are migrating to VPNs to meet their wide-area networking needs at lower costs, considerations specific to these topologies are required to be reflected in their customer-edge QoS designs. MPLS VPN QoS design is examined from both the enterprise and service provider's perspectives. Additionally, IPsec VPN QoS designs cover site-to-site and teleworker contexts. Whether you are looking for an introduction to QoS principles and practices or a QoS planning and deployment guide, this book provides you with the expert advice you need to design and implement comprehensive QoS solutions.

The recent trend towards the interoperability of traditionally separate networks, such as terrestrial, wireless/cellular, and satellite, for the support of multimedia applications poses new and significantly challenging problems to network design. This book reports on the state-of-the-art work developed during the four years of operation of the COST 279 Action, Analysis and Design of

Advanced Multiservice Networks supporting Mobility, Multimedia, and Internetworking, by its participating researchers, originating from over 40 research institutions from the academic, industrial, and telecom operator worlds. The work includes both fundamental, methodological, and applied aspects of network performance evaluation and design. Analysis and Design of Advanced Multiservice Networks Supporting Mobility, Multimedia, and Internetworking contains a detailed account of the work developed, supported on an extensive bibliography of material published in the peer-reviewed literature. It contains the following six chapters: IP-Based Networks Queueing Models Traffic Measurement, Characterization, and Modeling Wireless Networks Optical Networks Peer-to-Peer Services Analysis and Design of Advanced Multiservice Networks Supporting Mobility, Multimedia, and Internetworking will appeal to both practitioners of network design, and to researchers aiming to map future directions in networking research.

"This book reviews methodologies in computer network simulation and modeling, illustrates the benefits of simulation in computer networks design, modeling, and analysis, and identifies the main issues that face efficient and effective computer network simulation"--Provided by publisher.

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Here is a thorough, not-overly-complex introduction to the three technical foundations for multimedia applications across the Internet: communications (principles, technologies and networking); compressive encoding of digital media; and Internet protocol and services. All the contributing systems elements are explained through descriptive text and numerous illustrative figures; the result is a book well-suited toward non-specialists, preferably with technical background, who need well-composed tutorial introductions to the three foundation areas. The text discusses the latest advances in digital audio and video encoding, optical and wireless communications technologies, high-speed access networks, and IP-based media streaming, all crucial enablers of the multimedia Internet.

Multimedia data are used more and more widely in human being's life, e.g., videoconferencing, visual telephone, IPTV, etc. Nearly most of the applications need multimedia transmission techniques that send multimedia data from one side to another side and keep the properties of efficiency, robustness and security. Here, the efficiency denotes the time cost of transmission operations, the robustness denotes the ability to survive transmission errors or noises, and the security denotes the protection of the transmitted media content. Recently, various intelligent or innovative techniques are invented, which bring vast performance improvements to practical applications. For example, such content transmission techniques as p2p, sensor network and ad hoc network are constructed, which adaptively use the peers' properties to improve the network's resources. Multimedia adaptation techniques can adjust the multimedia data rate in order to be compliant with the network's bandwidth. Scalable encryption techniques can generate the data stream that can be correctly decrypted after bit rate conversion. Ubiquitous multimedia services make the user share any kind of content anywhere. The book includes fourteen chapters highlighting current concepts, issues and emerging technologies.

Distinguished scholars from many prominent research institutions around the world contribute to the book. The book covers various aspects, including not only some fundamental knowledge and the latest key techniques, but also typical applications and open issues. For example, the covered topics include the present and future video coding standards, stereo and multiview coding techniques, free-viewpoint TV techniques, wireless broadcasting techniques, media streaming techniques, wireless media transmission techniques and systems, and User-Generated Content sharing.

We are happy to welcome you to the IFIP Protocols for High-Speed Networks '96 workshop hosted by INRIA Sophia Antipolis. This is the fifth event in a series initiated in Zurich in 1989 followed by Palo Alto (1990), Stockholm (1993), and Vancouver (1994). This workshop provides an international forum for the exchange of information on protocols for high-speed networks. The workshop focus on problems related to the efficient transmission of multimedia application data using high-speed networks and internetworks. Protocol for High-Speed Networks is a "working conference". That explains we have privileged high quality papers describing on-going research and novel ideas. The number of selected papers was kept low in order to leave room for discussion on each paper. Together with the technical sessions, working sessions were organized on hot topics. We would like to thank all the authors for their interest. We also thank the Program Committee members for the level of effort in the reviewing process and in the workshop technical program organization. We finally thank INRIA and DRET for their financial support to the organization of the workshop.

Computer Networks: A Systems Approach, Fifth Edition, explores the key principles of computer networking, with examples drawn from the real world of network and protocol design. Using the Internet as the primary example, this best-selling and classic textbook explains various protocols and networking technologies. The systems-oriented approach encourages students to think about how individual network components fit into a larger, complex system of interactions. This book has a completely updated content with expanded coverage of the topics of utmost importance to networking professionals and students, including P2P, wireless, network security, and network applications such as e-mail and the Web, IP telephony and video streaming, and peer-to-peer file sharing. There is now increased focus on application layer

issues where innovative and exciting research and design is currently the center of attention. Other topics include network design and architecture; the ways users can connect to a network; the concepts of switching, routing, and internetworking; end-to-end protocols; congestion control and resource allocation; and end-to-end data. Each chapter includes a problem statement, which introduces issues to be examined; shaded sidebars that elaborate on a topic or introduce a related advanced topic; What's Next? discussions that deal with emerging issues in research, the commercial world, or society; and exercises. This book is written for graduate or upper-division undergraduate classes in computer networking. It will also be useful for industry professionals retraining for network-related assignments, as well as for network practitioners seeking to understand the workings of network protocols and the big picture of networking. Completely updated content with expanded coverage of the topics of utmost importance to networking professionals and students, including P2P, wireless, security, and applications Increased focus on application layer issues where innovative and exciting research and design is currently the center of attention Free downloadable network simulation software and lab experiments manual available

Compared with conventional communications, cooperative communication allows multiple users in a wireless network to coordinate their packet transmissions and share each other's resources, thus achieving high-performance gain and better service coverage and reliability. Energy Efficient Cooperative Wireless Communication and Networks provides a comprehensive look at energy efficiency and system design of cooperative wireless communication. Introducing effective cooperative wireless communication schemes, the book supplies the understanding and methods required to improve energy efficiency, reliability, and end-to-end protocol designs for wireless communication systems. It explains the practical benefits and limitations of cooperative transmissions along with the associated designs of upper-layer protocols, including MAC, routing, and transport protocol. The book considers power efficiency as a main objective in cooperative communication to ensure quality-of-service (QoS) requirements. It explains how to bring the performance gain at the physical layer up to the network layer and how to allocate network resources dynamically through MAC/scheduling and routing to trade off the performance benefits of given transmissions against network costs. Because the techniques detailed in each chapter can help readers achieve energy efficiency and reliability in wireless networks, they have the potential to impact a range of industry areas, including wireless communication, wireless sensor networks, and ad hoc networks. The book includes numerous examples, best practices, and models that capture key issues in real-world applications. Along with algorithms and tips for effective design, the book supplies the understanding you will need to achieve high-performing and energy efficient wireless networks with improved service coverage and reliability.

How prepared are you to build fast and efficient web applications? This eloquent book provides what every web developer should know about the network, from fundamental limitations that affect performance to major innovations for building even more powerful browser applications—including HTTP 2.0 and XHR improvements, Server-Sent Events (SSE), WebSocket, and WebRTC. Author Ilya Grigorik, a web performance engineer at Google, demonstrates performance optimization best practices for TCP, UDP, and TLS protocols, and explains unique wireless and mobile network optimization requirements. You'll then dive into performance characteristics of technologies such as HTTP 2.0, client-side network scripting with XHR, real-time streaming with SSE and WebSocket, and P2P communication with WebRTC. Deliver superlative TCP, UDP, and TLS performance Speed up network performance over 3G/4G mobile networks Develop fast and energy-efficient mobile applications Address bottlenecks in HTTP 1.x and other browser protocols Plan for and deliver the best HTTP 2.0 performance Enable efficient real-time streaming in the browser Create efficient peer-to-peer videoconferencing and low-latency applications with real-time WebRTC transports

Wireless sensor networks (WSNs) are a special class of ad hoc network in which network nodes composed of tiny sensors pass data such as temperature, pressure, and humidity through the network to a central location. Wireless sensor multimedia networks (WSMNs) are a special category of WSNs in which the sensor nodes are small cameras and microphones that can send voice, image, or video data through the network. This book presents the latest advances and research in WSMN architecture, algorithms, and protocols. WSMNs are attracting great attention from academia and industry due to the variety of applications in which they can be deployed. Wireless Sensor Multimedia Networks: Architectures, Protocols, and Applications explores the many benefits of WSMNs and the variety of applications in which they can be used—surveillance, traffic monitoring, advanced healthcare (blood pressure and heart rate monitoring), habitat monitoring, and localization services (finding missing children or wanted criminals). The contributed chapters in this book explore current research into key areas such as New quality-of-service-aware routing protocols that support a high data rate in WSMNs Cognitive radio capability that increases efficiency of spectrum utilization and decreases the probability of collision and contention Multimedia streaming optimization techniques New security schemes for real-time video streaming Various ways of optimizing power consumption in WSMNs Wireless Sensor Multimedia Networks: Architectures, Protocols, and Applications discusses open research issues and future trends in WSMNs. With this book, academic researchers, engineers, and graduate students will be well-equipped to advance the research in this emerging field.

bull; Demonstrates how real-time audio and video is packetized for transmission. bull; Explains the details of the RTP standards and related concepts. bull; How to implement RTP to work around network problems and limitations

Although there are many books available on WSNs, most are low-level, introductory books. The few available for advanced readers fail to convey the breadth of knowledge required for those aiming to develop next-generation solutions for WSNs. Filling this void, Wireless Sensor Networks: From Theory to Applications supplies comprehensive coverage of WS

This practical resource provides a survey on the technologies, protocols, and architectures that are widely used in practice to implement networked multimedia services. The book presents the background and basic concepts behind multimedia networking, and provides a detailed analysis of how multimedia services work, reviewing the diverse network protocols that are of common use

to implement them. To guide the explanation of concepts, the book focuses on a representative set of networked multimedia services with proven success and high penetration in the telecommunication market, namely Internet telephony, Video-on-Demand (VoD), and live IP television (IPTV). Contents are presented following a stepwise approach, describing each network protocol in the context of a networked multimedia service and making appropriate references to the protocol as needed in the description of other multimedia services. This book also contains questions and exercises to provide the reader with insight on the practical application of the explained concepts. Additionally, a laboratory practice is included, based on open-source tools and software, to analyze the operation of an Internet telephony service from a practical perspective, as well as to deploy some of its fundamental components.

Multimedia Networks Protocols, Design and Applications John Wiley & Sons

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(Computer Books)

A rapidly growing number of services and applications along with a dramatic shift in users' consumption models have made media networks an area of increasing importance. Do you know all that you need to know? Supplying you with a clear understanding of the technical and deployment challenges, Media Networks: Architectures, Applications, and Standard

As the Internet has grown, so have the challenges associated with delivering static, streaming, and dynamic content to end-users. This book is unique in that it addresses the topic of content networking exclusively and comprehensively, tracing the evolution from traditional web caching to today's open and vastly more flexible architecture. With this evolutionary approach, the authors emphasize the field's most persistent concepts, principles, and mechanisms--the core information that will help you understand why and how content delivery works today, and apply that knowledge in the future. + Focuses on the principles that will give you a deep and timely understanding of content networking. + Offers dozens of protocol-specific examples showing how real-life Content Networks are currently designed and implemented. + Provides extensive consideration of Content Services, including both the Internet Content Adaptation Protocol (ICAP) and Open Pluggable Edge Services (OPES). + Examines methods for supporting time-constrained media such as streaming audio and video and real-time media such as instant messages. + Combines the vision and rigor of a prominent researcher with the practical experience of a seasoned development engineer to provide a unique combination of theoretical depth and practical application.

Appropriate for a first course on computer networking, this textbook describes the architecture and function of the application, transport, network, and link layers of the internet protocol stack, then examines audio and video networking applications, the underpinnings of encryption and network security, and the key issues of network management. Th

This book is a collection of invited papers that were presented at the Ninth IEEE International Symposium on Personal, Indoor and Mobile Radio Communications, September 5-8, 1998, Boston, MA. These papers are meant to provide a global view of the emerging third-generation wireless networks in the wake of the third millennium. Following the tradition of the PIMRC conferences, the papers are selected to strike a balance between the diverse interests of academia and industry by addressing issues of interest to the designers, manufacturers, and service providers involved in the wireless networking industry. The tradition of publishing a collection of the invited papers presented at the PIMRC started in PIMRC'97, Helsinki, Finland. There are two benefits to this tradition (1) it provides a shorter version of the proceedings of the conference that is more focused on a specific theme (2) the papers are comprehensive and are subject of a more careful review process to improve the contents as well as the presentation of the material, making it more appealing for archival as a reference book. The production costs of the book is subsidized by the conference and the editors have donated the royalty income of the book to the conference.

Digital media are rapidly changing the world in which we live. Global communications, mobile interfaces and Internet cultures are re-configuring our everyday lives and experiences. To understand these changes, a new theoretical imagination is needed, one that is informed by a conceptual vocabulary that is able to cope with the daunting complexity of the world today. This book draws on writings by leading social and cultural theorists to assemble this vocabulary. It addresses six key concepts that are pivotal for understanding the impact of new media on contemporary society and culture: information, network, interface, interactivity, archive and simulation. Each concept is considered through a range of concrete examples to illustrate how they might be developed and used as research tools. An inter-disciplinary approach is taken that spans a number of fields, including sociology, cultural studies, media studies and computer science.

Special Features: - Focuses on the topic of designing and implementing computer network information transfer protocols. While we are all becoming familiar with the Internet, which uses the Transfer Control Protocol/Internet Protocol (TCP/IP), many computer networking solutions have been and will continue to be based on other perhaps proprietary, secure protocols About The Book: This book focuses on the design and implementation of these computer network information transfer protocols. Using the Internet as a running case study throughout the book, the authors introduce a formal notation for writing network protocols and organize their discussion around protocol functions

The authors bring together all the diverse information network professionals and developers need to build IP-based multimedia and voice networks, including coverage on key technologies, protocols, standards, security, access, and more.

Sensor networks continue to grow in importance for modern communication networks. Communication protocols are at the core of these networks, determining their ability to function, their capabilities, and the environments in which they are able to operate. In chapters carefully selected from the popular Handbook of Sensor Networks, Sensor Network Protocols supplies a sharply focused reference on protocols, security, data processing, and energy management in communication sensor networks that is ideal for specialists in the field. Providing a succinct guide to the protocols currently used in advanced sensor networks, this book focuses on four main areas: routing protocols; data gathering and processing; security and reliability; and energy management. The book opens with a survey of the challenges and opportunities facing the field. Then, expert contributors authoritatively discuss routing technologies, next-generation

enabling technologies, comparative study of energy-efficient protocols for wireless sensor networks, techniques to reduce computation and communication energy consumption, energy-aware routing, localized algorithms for sensor networks, and much more. *Sensor Network Protocols* details the techniques and technologies that are at the heart of modern sensor networks. It is an ideal reference for anyone interested in designing, planning, or building emerging sensor and communications networks.

*Web Protocols and Practice: HTTP/1.1, Networking Protocols, Caching, and Traffic Measurement* is an all-in-one reference to the core technologies underlying the World Wide Web. The book provides an authoritative and in-depth look at the systems and protocols responsible for the transfer of content across the Web. The HyperText Transfer Protocol (HTTP) is responsible for nearly three-quarters of the traffic on today's Internet. This book's extensive treatment of HTTP/1.1 and its interaction with other network protocols make it an indispensable resource for both practitioners and students. Providing both the evolution and complete details of the basic building blocks of the Web, *Web Protocols and Practice* begins with an overview of Web software components and follows up with a description of the suite of protocols that form the semantic core of how content is delivered on the Web. The book later examines Web measurement and workload characterization and presents a cutting-edge report on Web caching and multimedia streaming. It concludes with a discussion on research perspectives that highlight topics that may affect the future evolution of the Web.

Numerous examples and case studies throughout.

Today, the internet and computer networking are essential parts of business, learning, and personal communications and entertainment. Virtually all messages or transactions sent over the internet are carried using internet infrastructure-based on advanced internet protocols. Advanced internet protocols ensure that both public and private networks operate with maximum performance, security, and flexibility. This book is intended to provide a comprehensive technical overview and survey of advanced internet protocols, first providing a solid introduction and going on to discuss internetworking technologies, architectures and protocols. The book also shows application of the concepts in next generation networks and discusses protection and restoration, as well as various tunnelling protocols and applications. The book ends with a thorough discussion of emerging topics.

Welcome to the fourth IFIP workshop on protocols for high speed networks in Vancouver. This workshop follows three very successful workshops held in Zurich (1989), Palo Alto (1990) and Stockholm (1993) respectively. We received a large number of papers in response to our call for contributions. This year, forty papers were received of which sixteen were presented as full papers and four were presented as poster papers. Although we received many excellent papers the program committee decided to keep the number of full presentations low in order to accommodate more discussion in keeping with the format of a workshop. Many people have contributed to the success of this workshop including the members of the program committee who, with the additional reviewers, helped make the selection of the papers. We are thankful to all the authors of the papers that were submitted. We also thank several organizations which have contributed financially to this workshop, specially NSERC, ASI, CICS, UBC, MPR Teltech and Newbridge Networks.

This work contains proceedings from the 1997 Multimedia Networking International Workshop. Features include: ATM transport and PCS; multimedia systems implementation frameworks; computer-supported co-operative work; adaptive applications; and quality of service.

The result of decades of research and international project experience, *Multimedia Communications and Networking* provides authoritative insight into recent developments in multimedia, digital communications, and networking services and technologies. Supplying you with the required foundation in these areas, it illustrates the means that will allow

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

The advent of multimedia technology is creating a number of new problems in the fields of computer and communication systems. Perhaps the most important of these problems in communication, and certainly the most interesting, is that of designing networks to carry multimedia traffic, including digital audio and video, with acceptable quality. The main challenge in integrating the different services needed by the different types of traffic into the same network (an objective that is made worthwhile by its obvious economic advantages) is to satisfy the performance requirements of continuous media applications, as the quality of audio and video streams at the receiver can be guaranteed only if bounds on delay, delay jitters, bandwidth, and reliability are guaranteed by the network. Since such guarantees cannot be provided by traditional packet-switching technology, a number of researchers and research groups during the last several years have tried to meet the challenge by proposing new protocols or modifications of old ones, to make packet-switching networks capable of delivering audio and video with good quality while carrying all sorts of other traffic. The focus of this book is on HeiTS (the Heidelberg Transport System), and its contributions to integrated services network design. The HeiTS architecture is based on using the Internet Stream Protocol Version 2 (ST-II) at the network layer. The Heidelberg researchers were the first to implement ST-II. The author documents this activity in the book and provides thorough coverage of the improvements made to the protocol. The book also includes coverage of HeiTP as used in error handling, error control, congestion control, and the full specification of ST2+, a new version of ST-II. The ideas and techniques implemented by the Heidelberg group and their coverage in this volume apply to many other approaches to multimedia networking.

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

Peterson's Graduate Programs in Engineering & Applied Sciences contains a wealth of information on colleges and universities that offer graduate degrees in the fields of Aerospace/Aeronautical Engineering; Agricultural Engineering & Bioengineering; Architectural Engineering, Biomedical Engineering & Biotechnology; Chemical Engineering; Civil & Environmental Engineering;

Computer Science & Information Technology; Electrical & Computer Engineering; Energy & Power engineering; Engineering Design; Engineering Physics; Geological, Mineral/Mining, and Petroleum Engineering; Industrial Engineering; Management of Engineering & Technology; Materials Sciences & Engineering; Mechanical Engineering & Mechanics; Ocean Engineering; Paper & Textile Engineering; and Telecommunications. Up-to-date data, collected through Peterson's Annual Survey of Graduate and Professional Institutions, provides valuable information on degree offerings, professional accreditation, jointly offered degrees, part-time and evening/weekend programs, postbaccalaureate distance degrees, faculty, students, degree requirements, entrance requirements, expenses, financial support, faculty research, and unit head and application contact information. As an added bonus, readers will find a helpful "See Close-Up" link to in-depth program descriptions written by some of these institutions. These Close-Ups offer detailed information about the specific program or department, faculty members and their research, and links to the program Web site. In addition, there are valuable articles on financial assistance and support at the graduate level and the graduate admissions process, with special advice for international and minority students. Another article discusses important facts about accreditation and provides a current list of accrediting agencies.

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