Preface

We are pleased to bring you this inaugural volume of Advanced Topics in Business Data Communications and Networking. The field of telecommunication is marked with rapid advances in wired and wireless technologies that enable sending and receiving of applications involving data and voice. Individuals involved in researching, improving, and using telecommunication and networking need a strong resource to provide ideas and information on the utilization and performance of the novel technologies that currently shape the field. Advanced Topics in Business Data Communications and Networking, Volume I presents a wide range of the most current research in the area of telecommunications and networking. This inaugural volume will assist researchers, educators, and professionals in understanding the necessary components for telecommunications and how to best adopt these elements into their own workplaces, and organizations throughout the world.

Chapter I, "*Strategic Outsourcing: Opportunities and Challenges for Telecom Operators*" by Varadharajan Sridhar of Management Development Institute, India addresses the issue of outsourcing in the context of telecommunications. Traditionally, firms outsource some or all of the non-core functions to vendors to reduce production cost. There are a large number of cases where information technology and associated processes are being outsourced and even off-shored to contractors in other countries so that firms acquire services at lower costs without sacrificing quality and efficiency. However, until recently telecom operators, have kept their core functions, such as network management, in-house. Rapid technological advances, high amounts of competition, dynamic markets, and the need for quick deployment of services have forced the operators to formulate innovative strategic outsourcing options. The author demonstrates through a case of a mobile operator in India, the issues and challenges of such strategic outsourcing options. He uses the case to describe how firms can mitigate the vulnerabilities of such outsourcing, including formulating clearly defined Service Level Agreements, and selecting suitable vendors.

Chapter II, "*Empirical Prediction of Computer-Network Evolution*" by Sami J. Habib of Kuwait University, Kuwait, discusses evolution of networks. As technology changes, networks evolve over time. It is impossible for a human network designer to evaluate all choices manually. The use of a computer aided design tool may be suitable for determining the tradeoffs in price, performance, and availability. This chapter discusses the use of the iCAD tool for determining network evolution. The tool is connected to four device libraries, each of which contains a set of devices such as Ethernet hubs, ATM switches, IP routers, gateways and their associated cost, capacity, number of ports, and type of wire. As technology changes, these device libraries are updated. The tool uses an evolutionary approach to determine the best network technologies in the presence of changing technology by maintaining the original devices and minimizing the upgrading cost. From the experiments it is found that Ethernet dominates ATM in the design of LAN and IP router dominates gateways for all site and backbone networks.

Chapter III, "*Suitability of IP Telephony in the Public Switched Telephone Network (PSTN): A Case Study*" by Hak Ju Kim, University of Houston–Clear Lake (USA) discusses IP telephony which is a prime example of converged service and holds a lot of promise in terms of low costs of operation as well as possibility of providing a number of value added services. Whether or not a company should convert its existing circuit switched-based telephony network to a packet switched IP telephony network is a debatable issue. The authors study a local telecommunications service provider that provides telecommunications services and equipment to residential and business customers. Using simulation tools, they discover that the IP telephony network would save about 73% of the link capacity of the circuit switched network. They also show that the same network could carry integrated service traffic at zero incremental cost. The value of the IP network is shown to be positive using the real options approach, and negative using the net present value approach. The researchers conclude that the profitability potential of IP networks is high and service providers will find such services to be quite lucrative.

Chapter IV, "*A Framework for High-Speed Networking*" by Abid A. Ajeeli and Yousif Al Bastaky, University of Bahrain, Bahrain, describes the construction of resilient networks. Resilient networks are important for organizations because they provide the maximum amount of availability without a lot of redundancy. The authors describe the building of such a high performance and resilient local area network for the University of Bahrain. This involved the upgrading of a legacy ATM network to a state-of-the-art gigabit network that connected the two campuses of the university at Sukhair and Issa-Town. The chapter includes an interesting discussion on how the switches are set up at the two campuses and also how virtual LANs are set up at the two campuses to minimize congestion in the network. By using a multi-layered approach that involved network hardware elements and network protocols, the design emphasizes resiliency. The network is built in such a way that it is able to support existing applications while providing a good opportunity for future growth as the needs of the two campuses change.

Chapter V, "*Updating on Gigabit Ethernet Implementation: The Case of a Large New Zealand Organization*" by Nurul I. Sarkar of AUT University, New Zealand, Catherine Byrne of Tonkin & Taylor Group Ltd., New Zealand, and Nabeel A. Y. Al-Qirim of United Arab Emirates University, UAE, reports a case study of a large New Zealand organization about the company's level and scope of Gigabit Ethernet (GigE) deployment, the problems the company encountered, network performance issues, and test results. The use of optical fiber for switch-to-switch connections have some obvious benefits, such as longer distance coverage, low attenuation, and less electromagnetic interference than the copper cables. However, the company under study used low-cost Cat 5e UTP cable as an alternative option to deliver 1 Gbps over 100 meters. The research findings show that the organization first achieved around 300 Mbps after the network upgraded to GigE. This limitation of the overall network throughput is mainly due to the low-end PC-based servers and the associated hardware. However, as expected with faster server hardware, the overall network throughput especially at server-to-server configuration is nearly up to 1 Gbps.

Chapter VI, "*Interaction Between MIMD-Poly & PIPD-Poly Algorithms and Other TCP Variants in Multiple Bottleneck TCP Networks*" by M. Chandrasekaran of Directorate of Technical Education, India, and R. S. D. Wahida Banu of Government College of Engineering, India, discusses two Polynomial Congestion Control Algorithms called MIMD-Poly and PIPD-Poly. The interaction between these two algorithms and other TCP variants in multiple bottleneck TCP Networks are presented. The chapter starts with the introduction and analysis of the non-linear congestion control algorithms that generalize the Additive Increase and Multiplicative Decrease algorithms. These algorithms provide additive increases using a polynomial of the inverse of the current size of window and multiplicative decreases using the polynomial of the current size of window. This chapter analyses the interaction between the two algorithms for the wired and wireless TCP networks. The compatibility of these algorithms is evaluated

through simulations. The results of simulations are compared with other TCP variants and it is shown that both algorithms perform well.

Chapter VII, "*A Systematic Approach to the Analysis and Configuration of Audio/Video-on-Demand Services*" by Xabiel G. Pañeda, David Melendi, Roberto García, Manuel Vilas, and Victor García of University of Oviedo, Spain, presents research on audio/video streaming services that play an important role in the Internet. Users are interested in watching news and video clips or listening to their favourite songs. Due to this, companies are encouraged to deploy this type of services. However, maintaining them in good condition is not a simple task, at least for people with little experience in this field. This chapter presents a formal method for carrying out the main tasks in order to reach the best performance of the service, namely analysis and configuration. Analysis to evaluate the most interesting content, the resource consumption, and the QoS are defined. Using this information, the method proposes some processes to help the content producer and the system administrator configure the service. Following all the steps defined in the proposed method, both content providers and system administrators can manage a high performance audio/video service.

Chapter VIII, "*Mobile Information Processing Involving Multiple Non-Collaborative Sources*" by Say Ying Lim, David Taniar, and Bala Srinivasan of Monash University, Australia, describes how the information processing can be carried out when users are on the run. The information that mobile users need is not always available on a single server. So they need to query two or more different servers, obtain the information on their mobile device, and perform some operations on the gathered information in order to satisfy their information needs. Such downloading and combining of information from non-collaborative sources may be useful for various applications related to entertainment, tourism, and business sales. The authors study server strategy where a mobile user queries a server, on-air strategy where a server broadcasts to several mobile users, and a client strategy where a mobile device performs local operations on cached data. They propose various examples and cases where combinations of these strategies are used for retrieving information from non-collaborative sources and study them to show that location based data play an important role in mobile information processing.

Chapter IX, "*Network Planning Algorithms for Optimizing Signalling Load in Mobile Networks*" by Vilmos Simon and Sándor Imre of Budapest University of Technology and Economics, Hungary, describes design of mobile networks. In the next generation IP based mobile networks the cell handover will cause incremental signaling traffic, which can be critical from the point of view of delay variation. It will worsen the quality parameters of the real-time services, which are the backbone of next generation mobile commercial services. By designing and implementing location areas in a cellular mobile network, the number of handovers can be decreased significantly. The authors designed and implemented two Location Area Designing algorithms: a location area forming algorithm and a cell regrouping algorithm that can help to guarantee QoS parameters in next generation networks. They used a realistic mobile environment simulator to generate input statistics on cell changes and incoming call for the algorithms. By comparing the values of the cost functions proposed by them, they showed that significant reduction could be achieved in the amount of the signalling traffic, the location update, and the total cost.

Chapter X, "*A Heuristic Solution to the Large Scale Cellular Telecommunication Network Expansion Problem*" by Joon-Yeoul Oh of Texas A&M University-Kingsville, USA, and John P. Mullen of New Mexico State University, USA, provides a new algorithm for design of a cellular network. The increasing demand for cellular phone services often leads to a situation in which existing capacity is no longer adequate, resulting in such unpleasant experiences as unstable connections, blocked call attempts, and dropped calls. A common solution to this problem is network expansion, in which new physical components are placed to assure satisfactory network performance. An optimal solution would be one that does so at the lowest possible cost, but for even moderately large networks, solving such problems

is extremely difficult or not practical. This research article presents a highly efficient heuristic algorithm that considers capacity and redundancy requirements, as well as cost. It finds a very good solution in minutes, instead of months or years, together with lower bounds on cost of an optimal solution. The article also demonstrates its relative efficiency and discusses each algorithm step in detail.

Chapter XI, "*Wireless Proxy: Distributed System to Mitigate the Effects of User Mobility Over Streaming Services on IEEE 802.11 Wireless LANs*" by Manuel Vilas, Xabiel G. Pañeda, David Melendi, Roberto García, and Victor García of University of Oviedo, Spain, describes wireless LANs that provide user mobility support. One problem associated with wireless LANs is the uncertainty associated with the process of handoff. Since users are responsible for choosing the time of handoff, it often results in periods of time when the mobile device remains connected to the old access point in spite of degradation of service. This severely affects the performance of streaming media. The authors propose a new method for automatic handoff of wireless LAN connection to a different access point that is available. This is done using a wireless proxy that monitors network conditions and initiates handoff when channel conditions detoriate. The authors test the method using commercial streaming platforms and off-the-shelf Wi-Fi devices and report that improvement in data rate after the handoff is almost instantaneous and the playback quality for audio/video services suffers little when using an automated distributed handoff system.

Chapter XII, "*Soft Decision Parallel Interference Cancellation for Multi-Carrier DS-CDMA*" by R. Radhakrishnan and K. R. Shankarkumar of Sri Ramakrishna Engineering College, and A. Ebenezer Jeyakumar of Government College of Engineering ,India, presents technical research on wireless communication. Mobile communication promotes greater personal security and communication from any remote place, time, or form in the world. Since a channel is very expensive, it is desirable to simultaneously allocate the available channel to multiple users. Multiple access schemes are used to allow many simultaneous users to share a common communication channel to communicate with each other. Multi-carrier DS-CDMA is found to be attractive in applications such as wireless networks, broadband local access and cellular telephony. However, the performance and capacity of a DS-CDMA system are limited by multiple access interference and near far problems. The authors propose a new technique for multi-user detection using Parallel Interference Cancellation. This technique provides a good compromise between complexity, latency, and performance.

Chapter XIII, "*Distributed Resources Management in Wireless LANs that Support Fault Tolerance*" by Ghassan Kbar and Wathiq Mansoor of American University in Dubai (AUD), UAE, discusses the management of resources in wireless networks. Wireless LAN technology provides flexibility and reliability for business computer users where wire-line installation proves impractical. Applying the proper Radio Resource management technique for wireless LANs will lead to better control of the wireless network performance in terms of reliability, availability, fairness, and scalability especially when deploying it on a large scale. Distributed Dynamic Resource Management deployed in mobile terminals and access points potentially improves the network availability and reliability compared to centralized management which is badly affected by single point of failure. In order to evaluate the performance of wireless LAN using Distributed Dynamic Resource Management, the system is analyzed using normal and binomial distributions under different conditions. The analytical results described in this chapter show a very good network performance when implementing distributed resources management technique for wireless LANs.

Chapter XIV, "*Cooperative Data Caching and Prefetching in Wireless Ad Hoc Networks*" by Mieso K. Denko of University of Guelph, Canada, states that caching and prefetching are predominantly used in wired networks in order to reduce network latency when answering queries through database lookup. The use of such techniques is also advisable for wireless ad-hoc networks for better network

performance. The authors propose a clustering architecture that allows localized and adaptive caching in order to reduce the delay in access when the user remains mobile. Effectiveness of any caching approach is dependant on the cache replacement policy that is adopted and in this case the cache replacement policy uses frequency of access and time of access as the two important measures for deleting unpopular files. The adopted cooperative caching, prefetching, and cache replacement policy is tested in a network simulator that uses a particular type of ad hoc routing protocol. The results show that the proposed method performs quite well in terms of average data accessibility, average query delay, and network traffic overhead.

Chapter XV, "*A Survey on Fuzzy Reasoning Applications for Routing Protocols in Wireless Ad-Hoc Networks*" by Essam Natsheh of King Faisal University, Saudi Arabia, provides an analysis of mobile wireless ad-hoc networks that are networks without infrastructure. In these networks, every node must discover its local neighbors and through those neighbors it must communicate to nodes that are out of its transmission range. These networks suffer from all kinds of uncertainty, randomness, and fuzziness. This leads to the need for highly adaptive routing protocols that are adaptable to high variability and uncertainty for these types of networks. Recently, many researchers adaptively optimize the ad-hoc routing protocols functions and parameters using the fuzzy reasoning algorithm (FRA). The FRAs are proposed to overcome the shortcoming of ad-hoc networks. In this paper the author presents a survey of fuzzy reasoning based routing for mobile ad-hoc networks. He discusses the main problems that have been solved by this class of routing protocols and identifies some drawbacks of the proposed methods and possible solutions.

Chapter XVI, "*Fuzzy Linguistic Knowledge for Active Queue Management in Wireless Ad-Hoc Networks*" by Essam Natsheh of King Faisal University, Saudi Arabia, states that in a mobile ad-hoc network, every node can work as a router. Every node has protocols and services to request and provides services to other nodes with the capability to handle congestions. Traditionally, the congestion handling is done through Transmission Control Protocol. This protocol sends congestion signal when the node's queue is full. Some studies showed that early dropping of incoming packet before reaching the maximum queue length is an effective technique to avoid congestion and to minimize the packet latency. As an example, Active Queue Management drops incoming packets before the queue is full. Mobile ad-hoc networks suffer from high network congestion. This substantiates the need for queue management algorithms that are adaptable to high variability and uncertainty for these types of networks. The proposed fuzzy logic-based queue management algorithm overcomes the shortcomings of ad-hoc networks.

Chapter XVII, "*Risk Factors to Retrieve Anomaly Intrusion Information and Profile User Behavior*" by Yun Wang of Yale University, Yale-New Haven Health System & Qualidigm, USA and Lee Seidman of Qualidigm, USA, shows that analyzing network traffic audit data can lead to detection of the anomalous network connections and for profiling user behaviors. It is important to do so to uphold the security of corporate networks. The authors use a data mining approach using bootstrap resampling and logistic regression to study this issue. They use a benchmark data that consists of seven weeks of TCP dump network traffic data and two weeks of testing data with 34 types of attacks. The authors identify 16 important risk factors that can determine whether a connection is anomalous or not. An important contribution of the research is that the risk factors that reduced the full data by 65% is still able to predict anomalous connections quite well and show comparable performance to the full dimensional data in terms of metrics like sensitivity, specificity, and accuracy. The knowledge of the risk factors that are discovered in this research can be used to filter network traffic or to develop other advanced detection systems.

Chapter XVIII, "*Network Setup for Secure Routing in Inter-Vehicle Communication Networks*" by Rania Wehbi, Ayman Kayssi, Ali Chelab, and Zaher Dawy of American University of Beirut, Lebanon,

describes communication in moving vehicles which is a challenging issue and falls under the realm of inter-vehicular communication. Inter-vehicular networks act as a wireless ad-hoc network where each vehicle acts as a node of the network. The issue of setup and maintenance of such networks is challenging because the vehicles are in motion and are passing through different location with differing connectivities. This research proposes a secure routing protocol called SERVEN that can achieve near instantaneous secure communication among vehicles. Different action steps of the protocol like hello, join, reply, challenge, not accept, accept, fired, and alert are fully described in this paper that explain step-by-step how this protocol works. Using a network simulator, the authors go on to show that for a network limited to 30 hops the time needed to accept a joining node is quite small and the bandwidth consumed in the worst case scenario is reasonable.

Chapter XIX, "*Metropolitan Broadband Networks: Design and Implementation Aspects, and Business Models*" by Antonios Alexiou, Research Academic Computer Technology Institute and University of Patras, Greece, Christos Bouras, Research Academic Computer Technology Institute and University of Patras, Greece, John Papagiannopoulos, University of Aegean, Greece, and Dimitrios Primpas, Research Academic Computer Technology Institute and University of Patras, Greece, details the adoption of a broadband network in the region of Western Greece. The network consists of a fiber optic and Ethernet based infrastructure that is used in the metropolitan area of the city of Patras. It also includes a wireless broadband municipal network that is implemented in the city of Messatida. The main aim of the broadband network is to connect the public services related buildings in the region. At the same time, the designers want to create competition among access providers and content providers so that the end user can benefit from the advanced infrastructure and its associated services. Technical issues related to the creation and maintenance of the hierarchical broadband infrastructure such as choice of technology and interconnection are discussed in this chapter. Several contending business models are proposed and the open access model is selected due to the advantages that it can provide to the broadband project.

The field of telecommunication and networking has become strategically important for most organizations within the past few years, and this continues to grow at a rapid pace. Professionals and educators alike will find that the Advanced Business Data Communication and Networking series is a constantly up-to-date tool necessary for understanding and implementing telecommunication and networking technologies into the daily lives of professors, researchers, scholars, professionals, and all individuals in general. An outstanding collection of the latest research associated with the effective use of wired and wireless networks, Advanced Business Data Communications and Networking, Volume I provides the latest research on telecommunication and their integral role in our ever-changing technological world.

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Editor-in-Chief
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