International Journal of Information Technology & Decision Making
Vol. 2, No. 4 (2003) 523–529

World Scientific
www.worldscientific.com

TELECOMMUNICATIONS THEORIES, MANAGEMENT, DEVELOPMENT, PRACTICES, AND APPLICATIONS IN INFORMATION TECHNOLOGY: ISSUES AND ANALYSIS

Guest Editors

BAHADOR GHAHRAMANI
Information Systems and Quantitative Analysis
College of Information Science and Technology
University of Nebraska at Omaha
Omaha, Nebraska 68182-0116, USA
Tel: (402) 554-3075, Fax: (402) 554-3400
bghahramani@mail.unomaha.edu

ZIXIANG TAN
School of Information Studies
4-185 Center for Science and Technology
Syracuse University
Syracuse, New York 13244-4100, USA
Tel: (315) 443-1410, Fax: (315) 443-5806
ztan@syr.edu

The primary purposes of this special issue are two-fold. First, this issue provides an arena for telecommunications' subject matter experts and scholars to present their research. Second, we aim to inform the journal readers of the new technologies, concepts, applications, innovations, and scientific breakthroughs in the field.

Keywords: Telecommunication systems; internet-based network system developments; network integration; information technology.

1. Telecommunications Concepts

Telecommunications covers a host of electronics, computer systems, Internet-based voice and data applications, and wired and wireless systems, including software, hardware, and integration network developments. The primary questions confronting scholars and scientists are: "What does the telecommunications technology hold in store for us in the second half-century of the Internet-based voice and data environment?" and "How will telecommunications technology revolutionizes the role of IT and decision making in the new millennium?" Predicting the future of the telecommunications technology requires expertise as well as an

in-depth knowledge of telecommunication systems, applications, standards, and practices.

In this dynamic, interrelated, and interdependent telecommunications environment, what is imagined is also within reach. This ability to move forward to a million-fold increase in the power of telecommunications technology will significantly improve and alter existing microelectronic-based products and services. Telecommunications research covers conceptual and strategic theories, empirical research, case studies, and analytical models focusing on development, design, management, and control of telecommunications in IT — enabling network operations, improving voice and data transmission capabilities, enhancing system operations, seeking organizational competitiveness, and taking advantage of market opportunities.

Telecommunications research can be further analyzed and divided into the following six categories:

(1) *New Trends in Service Management*: Management evolution, service planning, service assurance, web-based user care, and network-based help management.

- Management evolution — The combined effects of the Internet and the rapid, continuing decrease in the cost of bandwidth has changed how complex telecommunications systems are monitored and managed.
- Service planning — Encompasses systems that support the technical design, service pricing, and investment decisions that are prerequisite to providing an efficient, and cost effective service.
- Business planning — The twin drivers of rapid cost comparison for bandwidth and advances in the Internet are altering the long and short-term investment planning of carriers.
- Service assurance — Managing the interaction between the users and providers pertaining to contracted services.

(2) *Evolution of the Wide Area Network*: Driving technologies, Internet applications, silicon-based technologies, modulation technology, and photonic applications.

- Driving technologies — Telecommunications applications are changing significantly. There are two fundamental drivers: popularization of the Internet and the associated technologies; and advances in silicon devices, modulation techniques, and fiber optic transport of voice and data.
- Internet applications — Evolution of the Internet due to innovative client/server applications and remote access to supercomputer centers brought the Web browser into the telecommunications landscape.
- Silicon-based technologies — The increasing expansion of WAN usage is fueled by at least five factors: inexpensive storage technology; efficient processing power; portable communications devices; faster network core transport technology; and accessible user-friendly networks.

- Modulation technology — Migration to digital networks and introduction of trellis-coded modulation have significantly improved communication speed.
- Photonic applications — Fiber-optic transport has expanded the WAN capabilities and eliminated the bandwidth bottlenecks so that there are no limitations to speedy delivery of voice and data.

(3) *Enterprise Network Technology*: Technology trends, vision of the future, business drivers, key concepts, convergence technology, virtual private networks, and Internet-based technologies.

- Technology trends — Global communications using multiple media and emergence of virtual enterprises that combines providers with users and users with users.
- Vision of the future — The imminent integration of modern network infrastructures into a global fabric based on IP as a universal Layers 3 and 4 switching protocol that improves communications without regard to physical location or environmental elements.
- Business drivers — Communications applications that the modern global network centers are required to serve and the cost effectiveness of their services.
- Key concepts — Emerging network concepts that contribute to the improvement of voice and data transmission.
- Convergence technology — The integration of distinct legacy systems and telephony with modern Internet-based networks.
- Virtual private networks — Consolidating various communications media and converging them onto IP WAN to create specific LAN components.
- Internet-based technology — Explosion of Internet-based systems has brought greater public awareness of cyberspace technology.

(4) *Mobile and Personal Technologies*: Digital applications, enabling technologies, and new applications.

- Digital applications — Digital devices are the driving force for wireless systems and the processing engines for the wireless systems that require minimum amount of spectrum and interferences from multiple complex user networks.
- Enabling technologies — Technologies such as speech coding, network RF optimization, geolocation technology, digital and software radio applications, interference mitigation and capacity improvement technology, and other related technologies.
- New applications — Introduction of new applications such as File Transfer Protocol (FTP), e-mail, telnet Netnews, Internet, e-commerce, broadband, video, cable, and wireless have improved voice and data transmission.

(5) *Wireless Data Networking*: Standards, circuit-switched data applications, packet-switched data, new operational systems, network platforms, distributed client/server technology, and object oriented analysis.

- Standards — Telecommunications Industry Association (TIA) standards; European Telecommunications Standards Institute (ETSI) standards, and American National Standards Institute (ANSI).
- Circuit-switched data applications — Developed for air interfaces and for mobile stations (MSs) to provide for data transmission through wireless networks and the Internet.
- Packet-switched data — Designed for sharing radio and network resources.
- New operational systems — Consolidation of the wireless network types is a driving force behind the business needs of the mobile operators.
- Network platforms — The future generation of wireless products will have market-driven components, speedy concept-time-to-market features, and cost effective products.
- Distributed client/server technology — Application software, hardware, and interfaces define server capabilities and features for a network
- Object oriented analysis, design, and implementation — Global networks will incorporate object-oriented practices into their software, hardware, and interface architecture to improve network sustainability, reliability, and cost effectiveness.

(6) *Advances in Fiber Optics*: Multimodal and plastic fiber for LAN, optical amplifier technology, UV-induced fiber grating technology, microstructure optical fiber technology, high-capacity transmission technology, optical access networks, and optical transmission.

- Multimodal and plastic fiber for LAN — Reduction of the cost of fiber for light sources, detectors, and other fibers have improved fiber application in LAN systems.
- Optical amplifier technology — The development of Erbium-Doped Fiber Amplifiers (EDFAs) has improved fiber-optic communication systems.
- UV-induced fiber grating technology — The advancement in UV exposure technology improves variation of the grating period and the refractive index modulation that enhances fine-tuning of wavelength responses.
- Microstructure optical fiber technology — Introduction of these fibers that contain air holes that run along the length of the fiber has improved monitoring; guiding, and controlling light, including guiding light predominantly in the atmosphere; and implementing photonic bandgaps.
- High-capacity transmission technology — Improves the burgeoning global demand for new information services through the Internet and transmission of voice and data without physical limitations.
- Optical access networks — Various networks are connected to core networks implementing low- and medium-speed synchronous-optical-network (SONET) and synchronous-digital-hierarchy (SDH) TDM multiplexers.
- Optical transmissions — Advances in optical transmission have doubled the bandwidth every year and will continue to do so in the future.

The special issue further divides these six categories into two areas of interest: (1) telecommunications theories, research, and development; and (2) telecommunications practices, strategies, and applications. This provides telecommunications researchers, scholars, and parishioners a vehicle to expand their field of knowledge by answering some of the critical questions and addressing related issues.

2. Overview of the Papers in the Special Issue

Telecommunications research is the fuel that drives IT in the second-half-century of the Internet-based voice and data environment. It plays an essential role in the modern systems design and development applications. This special issue offers state-of-the-art manuscripts from subject matter experts, practitioners, and scholars in industry, consulting, and academia with years of experience and accumulated knowledge in the field. The papers selected for this special issue are a comprehensive collection of studies that provides readers with the depth and breadth of telecommunications in the new millennium. Therefore, the manuscripts selected for this special issue primarily cover two areas: telecommunications theories, algorithms, and strategies; and telecommunications' practices, system design and development, and applications.

2.1. *Telecommunications theories, algorithms, and strategies*

K. D. Hackbarth *et al.* deal with the development of a strategic network planning and development model for hybrid 2G–3G wireless networks that relate to radio propagation, multi-service traffic, and user mobility. The research also analyzes strategic planning tools that can track the evolution of a wireless network under various service topographic scenarios. The developed tool combines technology and financial tools to provide an initial forecast of the investment and financial risk. To prepare this model, knowledge gained from previously developed strategic network planning tools was used.

P. C. Pendharkar *et al.* use a combination of a hybrid Bayesian network-based multi-agent system and distributed systems architecture to develop a drug crime knowledge management model. The research shows how the model can be implemented in the distributed computing network environment. In its final form, the developed hybrid model is capable of: (1) dynamically evaluating learning, and adjusting to the environment dynamics; (2) statistically analyzing and comparing performance of the model with the legacy tools; and (3) developing a distributed system architecture that can enhance the model's applications and performance.

A. Fleury *et al.* analyze how competencies and strategies can be developed and used to evaluate companies that are part of the international interorganizational networks. The research finds that in the telecommunications industry, strategic behavior of a firm depends on the formation of organizational competencies that leads to increasing complexity of the interorganizational networks. The research also concludes that the larger and more economically dominant firms tend to adapt

patterns of behavior that increase their complexities, such as providing high-level services that relate to their competencies and purchasing other firms that have developed specific market niches.

B. T. Han *et al.* use the design and planning of Local Access Network (LACN) technology to develop an Extended Capacitated Concentrator Location Problem (ECCLP) model that minimizes the total network costs through the selection of an optimal mix of contractors from a set of two primary and predetermined constraints. The ECCLP minimizes the total network costs by evaluating two primary constraints imposed on the contractors. The two constraints are total available connection ports and effective processing capacity. This research focuses on the development and testing of a Greedy Randomized Adaptive Search Procedure (GRASP) heuristic for solving ECCLP related problems. To implement the GRASP heuristic, fifty randomly generated test problems were successfully analyzed and solved using the model.

M. Kodialam *et al.* develop a robust and effective Quality of Service (QoS) model for multicasting that minimizes maximum transmission delay. The QoS considers the problem of optimally allocating a fixed amount of bandwidths to the links of a given multicast tree with a single broadcast node. The model uses real-time provisioning of bandwidths for multicast sessions. The research finds that resource reservation is the key step to provisioning a bandwidth for multicast sessions and determines the optimal link bandwidths for given multicast trees.

2.2. *Telecommunications practices, systems design and development, and applications*

A. Celik *et al.* develop a model for transmitting information to wireless appliances in the "pushed" or "pulled" modes of operations. The pushed process does not require waiting for requests for the item, but the pulled process requires response to a request for an item. The model determines the optimal allocation of bandwidth between pushed and pulled items.

P. K. Eswaran *et al.* examine the creation of an Enterprise IP Strategy from an economic and technology points of view and business prospective. The model provided factors that are required when implementing the model. The model helps businesses develop a blueprint to make the right decisions for their network requirements. The research concludes that sound enterprise IP strategy is critical to survival of a business because it directly impacts revenues, costs, and flexibility.

T. Bayrak *et al.* evaluate the performance of the real-time safety-critical WANs. The evaluation indicates mixed empirical results from increases in network usage and redundancy that underlines the importance of monitoring network performance at system and local levels. To be objective, the research focuses on establishing a technical foundation without any references to the human factors impacts on performance. The results indicate that operators' performance depends on two types of variables: technical variables such as network reliability and response time, and group variables such as workload and vigilance level.

M. Yearly *et al.* develop a device called Internet Data AcQuistion (DAQ) that addresses two major energy saving barriers: difficulty of retrieving energy data, and costly data logging equipments. The DAQ addresses both of these two barriers by constructing an embedded system that performs efficiently, gathers data, and makes the information available through the Internet. The research discusses the hardware, software, and interface in detail. It also discusses how the device adds a Web interface to sensors to standardize the Internet connections and query.

D. Guster *et al.* analyze the network performance of high speed Ethernet and ATM when they are configured as LAN backbones. The research finds that ATM has a performance superior to high speed Ethernet. The results show that when adjustments are made for differences in line speed, the ATM and high speed Ethernet throughputs are identical. The research also evaluates and compares the empirical data of the two technologies' performance and discusses advantages and disadvantages of each.

B. Ghahramani's research develops a new online and Internet-based Lean Management Information System (LMIS) for a metropolitan utility company that replaces the outdated legacy system. The LMIS alleviates the shortcoming of the legacy system, increases customer satisfaction, and meets the company's requirements. The real-time system capability monitors information flow, validate the results, helps process run, stores information, and develops query reports. The user interface of the system is a front-end using Visual Basic that generates reports using SQL statements.

Acknowledgments

Twenty manuscripts were selected from a pool of about thirty manuscripts submitted by interested authors. All twenty manuscripts were reviewed by at least three reviewers selected from the contributing authors, outside authors, and special issue editors. Based on the reviewers' comments, fourteen papers were selected for further revisions. The revised manuscripts were compared with their corresponding reviewers' comments, verified, and either accepted or rejected. The authors' self-evaluations and comments on the reviewers' concerns were carefully reviewed, addressed, and noted. Eleven papers were finally accepted for publication in the special issue.

The special issue editors would also like to extend their deepest gratitude to all the authors for trusting us with their manuscripts, helping us during the review process, reviewing other authors' papers, and patiently waiting for their final notifications. We are grateful to our outside reviewers Professors Bezalel Gavish, Hasan Pirkul, Yan Xu, and Sufi M. Nazem for their genuine support of this undertaking.

The special issue editors would like to take this opportunity to thank the chief editor Professor Yong Shi for his continuing support, input, and direction. We appreciate his insight and interest in the theme of the special issue; and its contents, manuscripts, authors, and reviewers.