

Foreword

INTRODUCTION

For 30 years I taught graduate courses, consulted for many companies and governments around the world, and did research in the area of information systems and telecommunications as well as spending several years as the CIO of a telecommunications company. I wish I had this book to provide the valuable data, information, knowledge, recommendations, experiences and guidance contained herein for all those activities.

We live in the age of communications and the policies, regulations, technologies, services, economics, infrastructure, planning, design and end user demands throughout the worldwide telecommunications industry produce forces that are now pushing the industry forward at a rapid pace. The end user's demand for more bandwidth; increased reliance on mobility services; desire for better security and privacy, and the end users' assessment of cost versus performance are driving the providers, regulators, researchers, and policy makers to reassess all aspects.

Thus far, the industry has reacted to these forces driving major infrastructure and technological change through consolidation, as carriers merge and equipment suppliers struggle to survive. Both on the domestic and international levels, regulators and government agencies are struggling to cope with rapid, profound changes in an industry that had been predictable for more than 100 years.

The technologies underlying the industry's changing infrastructure can be summed up as: IP transport's ability to merge voice, video and data; the long-haul fiber glut and the resulting reduction in the cost of bandwidth; the wide variety of local broadband wired and wireless solutions; and increasing security requirements; especially the ability to protect users on the Internet. The telecommunication's industry is riding the crest of worldwide demand for new video-enabled services. The emergence of video as a major force is reshaping mobile and fixed line telecommunications by the investment of large sums of money into new infrastructure which will cause a new telecommunication's landscape to be shaped. This new landscape will be formulated around the following 6 components:

1. Telecommunications Policy
2. Telecommunications Industry
3. Telecommunications Business Management
4. Telecommunications Technology Management
5. Telecommunications Technology and Applications
6. Telecommunications Network Design

This handbook presents empirically-based evidence that provides valuable information and knowledge along with recommendations for the participants in each of these components.

TELECOMMUNICATIONS POLICY

For policy makers, regulators, and legislators around the world, this book provides invaluable data and recommendations that will help them deal with policies related to the tremendous growth in telecommunications and the demand for new, high performance services. Regulators in many countries are finding that existing regulatory frameworks are not suitable for dealing with these new services and related technologies. A framework in this section of the book is presented that is comprised of five major components: consumer and intellectual property protection, market and resources access, and environmental protection. New and innovative approaches are discussed in many chapters related to these issues. Since wireless/mobile technologies are currently at the center of many policy and regulatory issues suggested reforms in the radioelectric spectrum management mechanisms and rational assignment and use of the radion spectrum are discussed in several chapters of this section. The role of regulation on incentives to invest in telecommunications in Europe, Australia, and the United States, especially in Next Generation Access Networks (NGA), is presented in both quantative as well as qualitative terms. Policy makers and regulators around the world will find this section highly useful.

TELECOMMUNICATIONS INDUSTRY

The telecommunications industry is undergoing changes that have an effect on revenues, costs, market share, profitability, competition, planning, efficiency, operations, personnel, and management practices. This section of the book provides extremely useful data, information, knowledge, and innovative insights into these topics. The convergence of IT and telecommunications and the emergence of new technologies and new entrants with new business models are discussed in several chapters of this section of the book. The local exchange telephone market is no longer considered to be a natural monopoly as a result of technological advancements. Digital technology has enabled traditional telecommunications companies to transition their network architecture from one based on copper wires and circuit switches for providing high quality transmission of point-to-point voice signals to a multi-faceted, general network based on fiber optic cables and packet switches capable of providing an array of voice, data, and video services. As noted in one chapter, convergence is fundamentally changing the nature of what it means to be a telecommunications company. One example of the impact of convergence presented in this section is what is happening in Korea. In Korea, the home network industry has been the object of great expectations among the government and business community. Thus far, however, it has proved unable to fulfill these expectations. On the basis of analyses, this chapter offers policy suggestions from a digital convergence perspective to help remove the obstacles to business cooperation among the participant industry sectors of the home network industry. Managerial implications for the participating firms are discussed in terms of adopting a new business model framework. The Internet has developed into a global network enabling users worldwide to connect to each other to exchange information and data. The initial peering arrangements have generally been replaced by commercial transit arrangements, as backbone providers seek to recoup their network infrastructure investments and generate commercial profits. This

is a key cause of the issues and debates that have emerged between developed and developing countries about international Internet interconnection services (IIS). This book presents data on current interconnection settlement arrangement models that disfavor ISPs and end-users in the Asia-Pacific region and summarizes the main current IIS issues between the Asia-Pacific and Western regions. As part of the industry analysis the book presents a techno-economic analysis of Mobile Virtual Network Operators by examining cross-national data in order to identify possible factors related to the observable patterns of Mobile Virtual Network Operator (MVNO) penetration including an economic assessment of market structure and environment for different countries' MVNO penetration. Fiber optics forms one of the industry's pivotal telecommunications technologies of the global economy, offering greater speed and security than other modes. Fiber's role in contemporary urban restructuring is discussed. One chapter in the book analyzes and discusses the spatial distribution of the world's fiber lines, noting major transatlantic and transpacific markets and newer systems. The enormous construction boom of the 1990s and early 2000s which led to severe overcapacity, with significant economic fallout is presented. One chapter in the book analyzes the role of non-market actions (NMA's) in firms' competitive position within the European mobile telecommunications industry. The bases of non-market actions are reviewed and classified as well as the use of non-market actions by the mobile phone operators is described using a particular case to describe the relationship between the use of legal actions and the first mover advantage in the European mobile telecommunications industry.

TELECOMMUNICATIONS BUSINESS MANAGEMENT

Having taught courses and performed research in the area of telecommunications and information systems for a major university for over 30 years, it was quite a transition when I became the Chief Information Officer (CIO) for a Telecommunications company and discovered the "business" of telecommunications. This book provides a number of extremely useful chapters on the business management aspects of telecommunications which I wish I had read before having to learn it on the job. Telecommunications is a business that has many aspects that traditional business and planning models do not encompass. One example of trying to deal with some of the idiosyncratic aspects of the telecommunication's business is the chapter that examines an implementation of an Activity-based Costing (ABC) system in a Portuguese telecommunications firm called Marconi. It is argued that they changed its management accounting system due to efficiency and institutional pressures from its constituencies, namely the Portuguese telecommunications regulators, its managers, and its competitors following the liberalization of the Portuguese and European Union telecommunications market. A chapter examines business process innovation which involves creating systems and methods for improving organizational performance and the interesting and innovative topic of intelligent networking which represents the combination of software, technology and electronic pathways that makes business process innovation possible for both large and small organizations based on the central tenet that an intelligent network is not one network, but a series of networks designed to enhance worldwide communication for business and residential users. Other chapters focus on the internationalization processes of national telecommunications companies (telcos) which have moved from a domestic monopoly to a player within the global industry. Every organization has a culture which guides its policies and management principles and can not be ignored. Several chapters in the book present data on the importance of organizational culture for the management of any organization, the theoretical link between organizational culture, and a variety of

variables which affect organizational performance and efficiency, directly and indirectly. Such variables are knowledge management, organizational climate, leadership, quality, innovation and entrepreneurship, human resource management, and employee behavior. Planning is essential for any organization and is especially important in a fast changing industry such as telecommunications. Planning and operational management models are presented in several chapters of this section of the book which encompass business strategies, knowledge management, customer satisfaction, customer demand, churn reduction, cost-benefit analysis, investment analysis, upgrade strategies, adoption of new technologies (such as VoIP), convergent technologies, and human factors. These are discussed in the context of various countries, technologies, and business domains including academia.

TELECOMMUNICATIONS TECHNOLOGY MANAGEMENT

Telecommunications is functionally dependent on a wide array of technologies. These technologies have been changing at a rapid pace thereby producing an array of technological issues that have placed a greater emphasis on managing these technologies. This book presents empirical data as well as theory-based accounts related to managing the many issues created by these new technologies. For example, the diffusion of a Web products or services is unlike traditional consumer or industrial goods but is characterized by recurring utilization and the permanent supervision of a platform regarding its compliance with qualitative, as well as ethical and legal standards. Web Services technologies enable the proper communication of processes deployed in quite hostile environments such as the Internet. Cellular networks have experienced significant changes over the last few years. In order to keep up with this constant evolution, planning tools must also adapt themselves in order to reflect the particularities and architecture of each generation. Voice over IP or VoIP is the use of Internet protocols to provide telephone services that have previously been delivered over traditional telephone networks. Advantages of VoIP include cost, portability, and functionality as a replacement to traditional telephone services but as pointed out in several chapters there are risks associated with VoIP services which impact quality and security of the phone system for voice communications. The chapter on the basics of technology management focuses on management functions, the managed objects, the management information base, and the management protocols. The fundamentals of communication management protocols have changed with the most widely used protocol, the Simple Network Management Protocol (SNMP) but new open system management protocols and the mobile internet management protocols are used for Authentication, Authorization and Accounting (AAA). One chapter in this section points out that IP network connectivity is becoming as important for businesses as basic utilities. IP addresses are among the most important resources to be managed. Ready access and flawless handling of IP address usage, assignment, tracking and reallocation help in enhancing network reliability and security, while enabling more efficient network expansion and troubleshooting. The chapter on managing IP Addresses is the best one on this subject that I have ever read. The chapter, "Planning of Wireless Community Networks", discusses the applications, state-of-the-art technologies, planning methods and business models for wireless community networks and provides an integrated presentation of these essential parts with examples which is invaluable for managing a wireless network.

TELECOMMUNICATIONS TECHNOLOGY AND APPLICATIONS

Technologies are useless until utilized for some application. Telecommunication organizations invest large sums of money in technologies with the assumption that they will receive a return on that investment based on how it is applied to provide services that generate revenue and/or reduce costs. But applying technologies for such purposes is filled with problems. The section of the book “Telecommunications Technology and Applications” discusses in a rather complete manner the problems and issues faced by providers in using technologies and especially new technologies for new and improved applications. The utilization of service and content delivery over the Internet is currently supported by overlay architectures of different types. There is a chapter which focuses on two issues related to IP, federated networks, namely: provider-to-provider agreements and enhancements to inter-domain routing protocols to convey QoS-related (Quality of Service-related) information. A concept called Meta-QoS-Class is introduced together with an enriched version of the Border Gateway Protocol. The chapter on the use of Web Services for management describes how Web Services allow the integration of low-level activities (e.g., retrieving monitoring information from gateways) with high-level business processes (e.g., creating a new product and its marketing strategy.). Despite clear advantages, Web Services-based management does not come for free; since Web Services are based on XML documents, its performance, compared with traditional management technologies, may represent an important drawback. The chapter on intrusion detection notes that most existing networks have been globally connected to open computer networks (Internet) in order to decentralize planning, management and controls in business but most of these networks were originally designed without security considerations, thereby making them vulnerable to cyber attacks. This has given rise to the need for efficient and scalable intrusion detection systems (IDSs) and intrusion prevention systems (IPSs) to secure existing networks which are discussed in detail. Fault management is presented as systems that are based on the analysis of Key Performance Indicators (KPIs) in order to identify the cause of network malfunctions. The chapters on m-based (Mobile based) commerce and pervasive computing and the use of agent technologies reveals many hidden issues in various applications. The discussion of a novel concept called Cognitive Radio for wireless telecommunications is fascinating. Cognitive radios are a new type of radio device that include cognition and reconfigurability features, thus creating a new paradigm for wireless environments. A chapter also describes the creative use of game theory for PHY layer and MAC sub-layer in Wireless Telecommunications. The chapter on high-speed multimedia networks: critical issues and trends is a very complete coverage of the range of technologies and standards ranging from Asynchronous Transfer Mode (ATM) and Fast Ethernet to Multi Protocol Label Switching (T-MPLS) and Optical Transport Network (OTN). Chapters on Open API and protocols as well as security concerns are well worth reading. The chapter on the role of telecommunications in Precision Agriculture illustrates how an application typically requires the convergence of several technologies to make the application a success. Since most farms are by definition rural and do not have high speed access to the Internet, the problem of moving 10’s, 100’s and even 1000’s of megabytes of essential information and data must be solved to help make precision agriculture easy to use and even transparent to the grower. Wireless technology can fill this gap and help make precision agriculture the standard in the future.

TELECOMMUNICATIONS NETWORK DESIGN

Having taught courses on network design and having been involved in designing several networks including a commercial DSL network, I could have benefitted from the chapters in this section of the book. In designing the DSL network, we had to utilize existing network facilities of an incumbent wireline company. Several chapters in this section emphasize that the network carrier must utilize the full potential of existing physical infrastructure before any new investments can be considered. There is a trend towards distributed computing and service creation in peer-to-peer and grid networks, which are able to overcome performance bottlenecks of client server architectures but these are not without issues that must be planned for and tested. One chapter focuses on planning and traffic engineering for link bandwidth and buffers as main resources in communication platforms based on measurement and statistical properties of traffic growth and variability which are critical for managing these technologies. Much work has been done to develop optimal design methodologies that generate a “best” design but designs often have to be changed to meet operational considerations, potentially mitigating any optimization benefits. One chapter in this section proposes to expand the optimal network design process by applying a process borrowed from Finance and Operations Research/Management Science literature known as the “Efficient Frontier” or production frontier analysis. Using this idea, a portfolio of designs differing in cost, and number, size and location of nodes will be developed and from that the efficient frontier defined. By comparing any subsequent design to the frontier, the network designer can have an understanding of the impact of changes in the design strategy to the long-term cost effectiveness. As one chapter notes; the cellular principle is an effective way to guarantee efficient utilization of the offered radio band and although PCS networks use the cellular principle, the next generation of PCS networks needs more improvements in location management to face the increased number of users. Both an Enhanced Profile-Based Strategy (EPBS) for small-scale roaming and a Caching Two-Level Forwarding Pointer (C2LFP) strategy for large-scale roaming are introduced. An evolutionary method, using a constraint Genetic Algorithm (GA) has been handled to achieve network parameters optimization and is presented in a case study format. A chapter in this section presents optimizing P2P Networks through adaptive overlay construction. Another chapter in this section presents a framework for solving a security-aware resource optimization problem under the SLA constraints of trustworthiness, percentile response time and availability using an efficient numerical procedure. The chapter on “Trends, Optimization and Management of Optical Networks” reviews optical networking, its current issues, trends, and ways to efficiently design and manage a wide range of optical networks. Efficient management and utilization of geographically different networks (such as wide area networks, metro networks, and access networks) present different optimization problems dealing with the placement of special optical equipment whose solutions are summarized in terms of current algorithmic approaches and suggest possibilities for further research.

SUMMARY

I highly recommend this book for professors teaching courses and performing research in network management, network analysis and design, network protocols, network regulations and standards, wireless networks, network performance metrics, telecommunication services, and network security. I would also recommend it to Masters and PhD students looking for ideas for a thesis.

For those working in the telecommunication industry whether it is at the operational level, managerial level or executive level, this book can provide solutions and approaches to existing problems as well as generate new approaches to services, control, and measuring performance. Likewise, anyone involved in networking at almost any level can benefit from one or more chapters of this book to provide a more responsive, efficient, secure, and service-oriented telecommunications network.

This book is a must for policy makers and regulators around the world starting the FCC in the United States to the appropriate bodies in Australia, United Kingdom, European Union nations, countries in the Far East such as China, and countries in the Middle East. The empirical data, creative analysis, and innovative recommendations for policy and regulation of this rapidly changing and high impact area affecting the social and political aspects of every country in the world are captured in this book.