# Book Review- Computer and Communication Networks, by Nader F. Mir Published by Prentice Hall in Nov. 2006

Sarhan M. Musa
**Department of Engineering Technology**
**Prairie View A&M University, Prairie View, Texas 77446**
**smmusa@pvamu.edu**

***Computer and Communication Networks*** book by Professor Nader F. Mir represents the explosive demand for learning computer communication science and engineering. Nonetheless, the text covers both the foundations and the latest advanced topics of computer networking. Because of its complexities at both hardware and software levels, the Internet is a challenge to those who want to study this field. The growing number and variety of communication services offer obvious challenges for computer network experts in designing cost-effective networks to meet the requirements of emerging communication systems. This textbook fills the gaps in current available texts.

**Introduction and Text High-Lights**

The textbook offers a mix of theory, architecture, and applications. The lack of computer communications books presenting moderate analysis with detailed drawing figures covering both wireline and wireless communication technologies led the author to write this book. The main objective of this book is to help readers learn the fundamentals and certain advance concepts of computer and communication networks, using a unified set of symbols throughout a single textbook. This book targets two groups of people. For people in academia, at both the undergraduate and graduate levels, the book provides a thorough design and performance evaluation of communication networks. The book can also give researchers the ability to analyze and simulate complex communication networks.

It would be impossible to cover all networking subjects in one textbook. The range of topics presented in this text, however, allows instructors to choose the topics best suited for their classes. Besides the explanations provided for each chapter, readers will learn how to model a communication network and how to mathematically analyze them. Readers of this text will benefit from the combination of theory and applications presented in each chapter, with the more theoretical portions of each chapter challenging those readers who are more ambitious.

For engineers who want to work in the communication and networking industry and need a reference covering various angles of computer networks, the book provides a variety of learning techniques: exercises, case studies, and computer simulation projects. The book makes it easy and fun for an engineer to review and learn from a reliable networking reference covering all the necessary concepts and performance models.

The text-book has been the essence of many years of author's experience in teaching and research in the field of computer communications. The high-lights of the text book are **as** follows:

- **Text-Book Title: Computer and Communication Networks**
- **Edition: First**
- **Number of Pages: 645 (Dense)**
- **Number of Chapters: 20**
- **Approximate Number of Drawing Figures: 200**
- **Approximate Number of Examples and Exercises: 300**
- **Case-Studies: Several long practical case-studies at the end of chapters.**
- **Computer Simulation Projects: Several simulation projects at the end of chapters.**
- **Approximate Number of Equations: Numerous throughout the text**
- **Instructor's Solution Manual: Yes**
- **Instructor's Power-Points: Yes**
- **Price: $64.99**

The text-book covers all aspects of fundamentals as well as some advanced topics in networking suitable for two back-to-back networking courses. The text-book can be used perfectly for instructors who teach fundamentals at both *senior undergraduate* or a *first-course graduate* and also for a following *advance level graduate course*.

**Organization of the Text**

The book is organized into 20 chapters in two main parts. The ten chapters of Part I cover the fundamental topics in computer networking, with each chapter serving as a base for the following chapter. Part I of the book begins with an overview of networking, focusing on TCP/IP schemes, describing wireless networking, and ending with a discussion of the World Wide Web (WWW) and network security. Part I is most appropriate for readers with no experience in computer communications. The ten chapters in Part II cover detailed analytical aspects and a closer perspective of advanced networking protocols: switches, routers, multiplexers, delay and congestion analysis, multimedia networking**, multicasting, data compression, voice over IP, optical networks, and sensor networks.**

***Chapter 1, Packet-Switched Networks***, introduces computer networks, touching on the need for networks, explaining relevant packet-switched networks, and giving an overview of today's Internet. Fundamental concepts, such as *messages*, *packets*, and *frames* and *packet switching* versus *circuit switching,* are defined. Various types of packets-witched networks are defined, and how a message can be handled by either *connection-oriented networks* or *connectionless networks* is explained. Finally, this chapter presents a detailed analysis of packet size and optimizations.

***Chapter 2,*** *Foundation of Networking Protocols,* presents the basics of the five layer Internet Protocol reference model, as well as other protocols: the seven layer OSI model and the *equal-size packet protocol* model.

***Chapter 3, Networking Devices****,* introduces the overall architectures of networking devices, such as multiplexers, modems, and switching devices. *Multiplexers* are used in all layers of network. Networking modems are used for access to the Internet from remote and residential areas. Finally, switching devices, such as hubs, bridges, switches, and routers, are used to switch packets from one path to another.

***Chapter 4, Data Links and Transmission,*** focuses on the links and transmission interfaces, the two basic components that networking starts with. This chapter presents both wired and wireless links and describes their characteristics, advantages, and channel access methods. This chapter also presents various *error-detection and correction* techniques at the link level and discusses the integrity of transmitted data. The chapter ends by presenting link-layer *stop-and-wait* and *sliding-window* flow control.

***Chapter 5, Local Area Networks and Networks of LANs,*** explores the implementation of small networks, using the functional aspects of the fundamental knowledge gained in Chapters 2, 3, and Chapter 4 on basic protocols, devices, and links, respectively. The chapter provides some pointers for constructing a network with those\ devices and making connections, gives several examples of local area networks (LANs), and explains how such LANs are internetworked.

***Chapter 6, Wireless Networks and Mobile IP,*** presents the basics of wireless networking. The chapter discusses challenges in designing a wireless network: *management of mobility*, *network reliability*, and *frequency reuse*. Next, the chapter presents an overview of wireless communication systems at all levels, from satellite to local-area networks and discusses wireless LANs and such standards as IEEE 802.11. The chapter then shifts to cellular networks, one of the main backbones of our wireless networking infrastructure. *Mobile IP* and *Wireless mesh networks* (WMNs), including WiFi and WiMAX technologies, are introduced at the end of this chapter.

***Chapter 7, Routing and Internetworking****,* focuses on routing in wide area networks (WANs) and introduces related routing algorithms and protocols. Our networking infrastructure is clearly classified into those networks that use optimal routes and those that use nonoptimal routes. These two classes of algorithms are described in detail. Routing protocols are also classified as those that are applied within a domain and those that are applied beyond a domain. This chapter also presents congestion-control algorithms: *network-congestion control* and *link-flow control*. The chapter also looks at *random early detection* for congestion control and describes a useful technique to estimate the link-blocking probability.

***Chapter 8, Transport and End-to-End Protocols,*** first looks at the basics of the *transport layer* and demonstrates how a simple file is transferred. This layer handles the details of data transmission. Several techniques for transmission control and protocol (TCP) congestion control are discussed. Next, *congestion-avoidance* methods, which are methods of using precautionary

algorithms to avoid a possible congestion in a TCP session, are presented. The chapter ends with a discussion of methods of ATM congestion control.

***Chapter 9, Applications and Network Management,*** presents the fundamentals of the *application layer*, which determines how a specific user application should use a network. Among the applications are the *Domain Name System* (DNS); *e-mail protocols*, such as SMTP, and the *World Wide Web* (WWW).

***Chapter 10, Network Security,*** focuses on security aspects of networks. After introducing network threats, hackers, and attacks, this chapter discusses encryption techniques: public- and private-key protocols, encryption standards, key-exchange algorithms, authentication methods, digital signature and secure connections, firewalls, IPsec, and security methods for virtual private networks.

***Chapter 11, Packet Queues and Delay Analysis,*** begins Part II, discussing Little's theorem, Markov chain theorem, and birth and death processes. Queueing-node models are presented with several scenarios: finite versus infinite queueing capacity, one server versus several servers, and Markovian versus non-Markovian systems. Non-Markovian models are essential for many network applications, as multimedia traffic cannot be modeled by Markovian patterns. In addition, delay analysis, based on networks of queues, is discussed. *Burke's theorem* is applied in both serial and parallel queueing nodes. *Jackson's theorem* is presented for situations in which a packet visits a particular queue more than once, resulting in *loops* or *feedback*.

***Chapter 12, Quality of Service and Resource Allocation***, covers quality-of-service issues in networking. The two broad categories of QoS discussed are the *integrated services approach*, for providing service quality to networks that require maintaining certain features in switching nodes; and the *differentiated services approach* (DiffServ), which is based on providing quality-of-service support to a broad class of applications. These two categories include a number of QoS protocols and architectures, such as *traffic shaping*, *admission control* , *packet scheduling* , *reservation methods*, the Resource *Reservation Protocol* (RSVP), and traffic conditioner and bandwidth broker methods. This chapter also explains fundamentals of resource allocation in data networks.

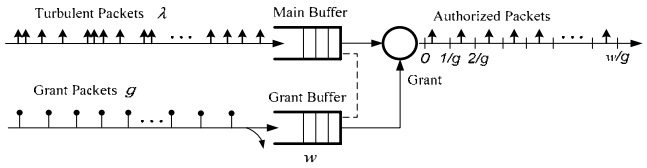


***Figure 1. An example of QoS traffic evaluation in Ch. 12.***

***Chapter 13, Networks in Switch Fabrics,*** looks inside switch fabrics of such Internet devices as routers. The chapter begins by classifying characteristics of switching networks and presenting features and basic definitions of switch fabrics. As the building blocks of switching fabrics, *crossbar switches* are emphasized. In particular, a case study at the end of chapter combines a number of buffered crosspoints to form a buffered crossbar. A number of other switch architectures—both blocking and nonblocking, as well as, shared-memory, *concentration-based*, and *expansion-based* switching networks are presented.

***Chapter 14, Optical Networks and WDM Systems,*** presents principles of fiber optic communications and networking. The optical communication technology uses principles of light emission in the glass medium, which can carry more information over longer distances than electrical signals can carry in a copper or coaxial medium.
The discussion on optical networks starts with basic optical devices, such as *optical filters*, *wavelength-division multiplexers* (WDMs), *optical switches*, and *optical buffers* and *optical delay lines*. After detailing optical networks using routing devices, the chapter discusses *wavelength re-use and allocation* as a link in all-optical networks. The chapter ends with a case study on an optical switching network, presenting a new topology: the *spherical switching network* (SSN).

***Chapter 15, Multicasting Techniques and Protocols,*** covers the multicast extension of routing protocols in the Internet. First, the chapter defines basic terms and algorithms: multicast group, multicast addresses, and multicast tree algorithms, which form the next set of foundations for understanding packet multicast in the Internet. Two main classes of protocols are discussed: *intradomain* multicast routing protocols, by which packets are multicast within a domain; and *interdomain* routing protocol, by which packet multicast among domains is managed. In addition, techniques and algorithms used within the hardware of routers are introduced.

***Chapter 16, VPNs, Tunneling, and Overlay Networks,*** introduces some useful Internet applications. The chapter explains how networks can be *overlaid* or *tunneled* and describes *virtual private networks* (VPNs), by which a private-sector entity tunnels over the public networking infrastructure,

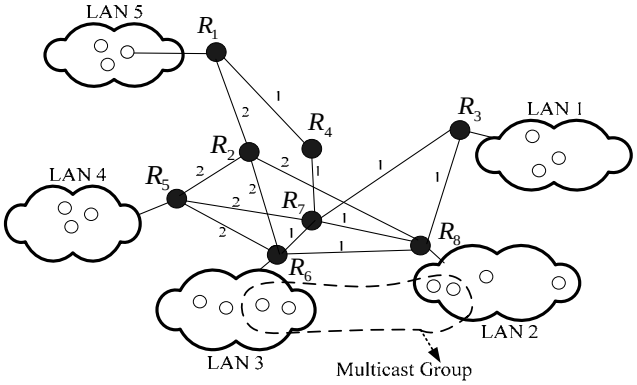


***Figure 2. An example of multicast grouping in Ch. 15.***

**maintaining private connections. Other, related topics in this chapter are *multiprotocol label switching* (MPLS) networks and *overlay networks*.**

***Chapter 17, Compression of Digital Voice and Video,*** focuses on data-compression techniques for voice and video to prepare digital voice and video for multimedia networking. The chapter starts with the analysis of information-source fundamentals, source coding, and limits of data compression and explains all the steps of the conversion from raw voice to compressed binary form, such as sampling, quantization, and encoding. The chapter also summarizes the limits of compression and explains typical processes of still-image and video-compression techniques,

such as JPEG, MPEG, and MP3. An end-of-chapter case study covers most of the chapter content, looking at FAX compression.

***Chapter 18, VoIP and Multimedia Networking,*** presents the transportation of real-time signals along with the signaling protocols used in voice over IP (VoIP) telephony and multimedia networking. The chapter presents protocols designed to provide real-time service requirements to the Internet. After discussing the *Session Initiation Protocol* (SIP) and the *H.323 series of protocols*, which are responsible for session signaling and numbering, real-time transport protocols, such as *Real-Time Transport protocol* (RTP) and the *Real-Time Control Protocol* (RTCP) are presented. The next topic is streaming video in a single server, using *content distribution networks* (CDNs). Also discussed is the *Stream Control Transmission Protocol* (SCTP), which provides a general-purpose transport protocol for transporting stream traffic. The chapter ends with detailed streaming source modeling and analysis.

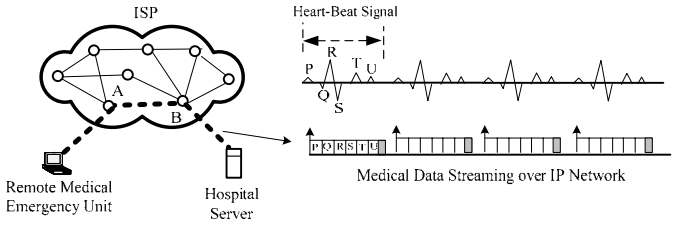


***Figure 3. An example of video streaming from a hospital to a doctor's office in Ch. 17.***

***Chapter 19, Mobile Ad-Hoc Networks,*** presents a special type of wireless networks, known as the *mobile ad-hoc network* (MANET). Ad-hoc networks do not need any fixed infrastructure to operate and support dynamic topology scenarios where no wired infrastructure exists. The chapter explains how a mobile user can act as a routing node and how a packet is routed from a source to its destination without having any static router in the network. The chapter also discusses *table-driven routing protocols* such as DSDV, CGSR, and WRP, and also *source-initiated routing protocols*, as well as DSR, ABR, TORA, and AODV. At the end of the chapter, we will discuss the security of ad-hoc networks.

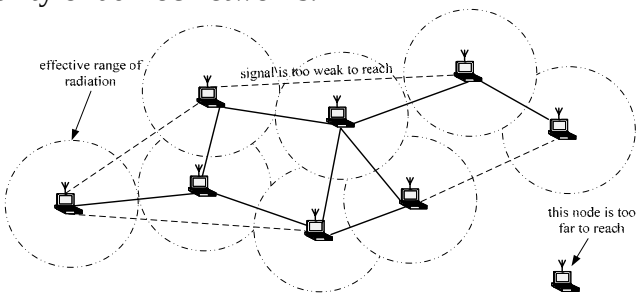


***Figure 3. An example of wireless ad hoc network Ch.18.***

***Chapter 20, Wireless Sensor Networks,*** presents an overview of such sensor networks and describes intelligent sensor nodes, as well as an overview of a protocol stack for sensor networks. The chapter explains how the "power" factor distinguishes the routing protocols of sensor networks from those of computer networks and describes *clustering protocols* in sensor

networks. These protocols specify the topology of the hierarchical network partitioned into nonoverlapping *clusters* of sensor nodes. The chapter also presents a typical routing protocol for sensor networks, leading to a detailed numerical case study on the implementation of a clustering protocol. This chapter ends with *ZigBee technology*, based on IEEE standard 802.15.4. This technology uses low power nodes and is a well-known low-power standard.

## Exercises and Computer Simulation Projects

A number of exercises are given at the end of each chapter. The exercises normally challenge readers to find the directions to solutions in that chapter. The answers to the exercises are not always simple and may be more elusive, but this is typical of real and applied problems in networking. These problems encourage the reader to go back through the text and pick out what the instructor believes is significant. Besides typical exercises problems, there are numerous occasions for those who wish to incorporate projects into their courses. The computer simulation projects are normally meant to be a programming mini-project. Projects listed in the exercises range from simulations to partial hardware design. Throughout the text are case studies that show how and where computer communication integration is used with the materials studied in the associated chapter. A case study is basically a practical example for better understanding the essence of the corresponding chapter.

## Appendixes

The book's appendixes make it essentially self-sufficient. Appendix A, Glossary of Acronyms, defines acronyms. Appendix B, RFCs, encourages readers to delve more deeply into each and every protocol presented in the book by consulting the many references provided. Appendix C, Probabilities and Stochastic Processes, reviews probabilities, random variables, and random processes.

## Instruction Supplements

The text can be used in a variety of ways. An instructor can use Part I of the book for the first graduate or a senior undergraduate course. In this case, one or two additional chapters from Part II, such as Chapters 13, 15, or 16, can also be included. Part II of the text is aimed at the second graduate course in computer communication networks. An instructor can also choose the desired chapters, depending on the need and the content of her/his course. For example, if the graduate course is geared more toward architectures, Chapters 12, 13, 14, and 15 would be appropriate. Nevertheless, an instructor can include a couple of chapters from Part I, such as Chapters 3 and 6, in her/his graduate course. An *instructor's solutions manual* is available to qualified instructors. Other instruction material, such as Power Point presentations will also be provided to instructors**.**

**Summary**

The book strives to fix the shortcoming materials in current networking textbooks. We mentioned that Part I present fundamentals of computer communication networks suitable for the first course in computer networking. Part II presents performance evaluations of data networks, advanced topics, and high-speed networks suitable for an advanced networking course. These two parts altogether would be a superb complementary to a fundamental first course in networking. The text-book can be considered for two back-to back courses where examples, figures, and symbols are related, consistent and unified.

The textbook also covers the evaluation of many practical applications in communications obtained from many years of experience. These unique studies have been incorporated in chapters under "case-studies". The book has been loaded with numerous "practical" examples and exercises in data communication systems making it attractive for those who wish to self-study as well. The book uniquely contains more than 200 illustrative figures which technically help a reader understand a corresponding analysis in a faster pace.

I am confident that the textbook will soon find its place in academia and industry and will establish itself as a leading textbook in computer networking.